DISTURBED ENVIRONMENTS: ECOLOGICAL IMPACT & MANAGMENT

ABSTRACTS

2012 Annual Conference
Mid-Atlantic Chapter
Ecological Society of America
April 14th & 15th, 2012

Virginia Tech
Blacksburg, Virginia

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Landscape history and contemporary environmental drivers of microbial community structure and function

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Microbial community assembly is potentially controlled by a combination of historical and contemporary processes operating over millennial to seasonal time scales. Here I present research investigating the influence of glacial history (historical legacy) and geochemical variation (contemporary environment) on the spatial distribution of soil microbes and their contribution to ecosystem processes. We collected samples in December 2010 from four different glacial till sequences in Taylor Valley, Antarctica, representing over 3 million years of soil development. Within each till unit, samples were collected from either areas that received seasonal sources of melt water or areas that were continuously dry. Using TRFLP of 16S rDNA fingerprints of microbial communities we derived community similarity and richness analyses across all sites. Extracellular enzyme activity of C-, N-, and P-acquiring enzymes provided an assessment of microbial community contribution to nutrient cycling. We found microbial communities were significantly influenced by both glacial tills (historical drivers) and local hydrology (contemporary driver). Community similarity was especially organized by water content, pH, phosphate, and soil organic carbon. The activity of C- and P-acquiring enzymes was more significantly influenced by glacial tills than hydrologic condition. However, N-acquiring enzyme activity was significantly influenced instead by hydrologic condition. The difference between enzymes and sites was strongly related to edaphic soil conditions therefore it is unlikely that microbial community identity influences their functional potential, indicating functional redundancy. Our work suggests that biogeography in microbial communities is co-organized by historical legacy and contemporary environments, while these broad functions are not dependent on community structure.

Host selection and spatiotemporal heterogeneity of viral hemorrhagic septicemia virus: inferences from hierarchical multi-scale occupancy models

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Surveillance for fish pathogens in wild populations is an effective step in establishing baseline prevalence and documenting geographic distribution and host range. However, reliable estimates of pathogen prevalence and infection status can be biased if infection status is determined from diagnostic tests subject to imperfect detection. In order to account for this potential source of bias, site-occupancy modeling has been presented as a framework for estimating disease prevalence while assessing test sensitivity, where each collected individual is treated as a potentially occupiable patch, but this approach has not been extended to virus surveillance in which individuals are collected from more than one locality. In this study of fish collected from 37 sites across the Laurentian Great Lakes, we investigated the prevalence of viral hemorrhagic septicemia virus (VHSV) within apparently healthy common wild fish species. In order to deal with the complex multi-level structure of this dataset, we used a multi-scale occupancy model formulated as a hierarchical state-space model utilizing reversible-jump Markov Chain Monte Carlo to determine risk factors for detecting VHSV within a fish at a locality, while accounting for imperfect diagnosis. Results from this procedure suggest that both cell culture and quantitative real time polymerase chain reaction are subject to imperfect diagnosis of VHSV and that some areas of the Great Lakes have higher virus prevalence than others. Our results demonstrate the advantages of extending site pathogen-occupancy modeling to multiple sites, and this approach can easily be extended to other fish and wildlife infection surveillance efforts.

Patterns of habitat utilization and evidence of competitive displacement in crayfish species in the Monocacy River

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We present data from three years (2009-2011) on the habitat utilization by three dominant species of crayfish in the Monocacy River, Maryland. The southern river is dominated by the native *Orconectes obscurus*. The middle section of the river is dominated by the non-native, *Orconectes virilis,* introduced ~50 years ago. The invasive *Orconectes rusticus* was recently introduced and is dominant in the northern river. It is displacing *O. virilis* as its range expands southward at a rate of 1-5 km y^{-1}. In the absence of interspecific competition, juvenile and adult *O. virilis* exhibited strong preference for spatially complex emergent vegetation beds. *O. rusticus* was abundant in all habitats sampled. This generalist strategy may provide an advantage which facilitates out-competing *O. virilis*. In the presence of competition, habitat utilization by *O. rusticus* was unchanged, but *O. virilis* was displaced from vegetation habitat. Juvenile *O. virilis* were present indicating successful reproduction at the site, but displacement was most intense in the young of the year life stage. The remaining adult *O. virilis* were larger than the maximum size attained by *O. rusticus* suggesting the presence of a size refuge for *O. virilis*. Species composition at the site dominated by the native *O. obscurus* was stable over the three years of our study suggesting that they were not being actively displaced by *O. virilis*. Our research group is presently examining potential mechanisms of displacement of *O. virilis* by *O. rusticus* including adult and juvenile behavior, fecundity, and juvenile growth and mortality.

Saving Stadium Woods

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Stadium Woods is a rare, 14-acre old-growth forest fragment remarkably preserved in the central core of the Virginia Tech campus. The forest contains 58 trees over three feet in diameter, mostly white oak. Four of these trees were cored to the extent possible and found to range between 232 and 346 years old. The multi-layered canopy and large amount of snags and coarse woody debris contribute to the old-growth character of the forest. Over 55 species of birds, including many neotropical bird species, frequented the forest in spring 2011. The forest has also seen large-scale disturbance as an unofficial dumping ground (fill dirt, concrete, stone, plant material, rubbish, etc.) over many years by the University. In the post World War II area, part of the forest served as a mobile-home park for returning GI's. Invasive species are a major problem.
In fall, 2011 the Virginia Tech Athletic Dept announced plans to place an indoor football practice facility in stadium woods, despite the fact that the woods are designated an environmental area in the university long-range plan and opposition by campus faculty. We will provide an overview of the forest's ecological character, its disturbance history and management, efforts to educate the campus community about its importance, and the policy and planning missteps that led to the present situation.

Bioindicators of soil quality in intercropped loblolly-switchgrass systems managed for biofuels

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Understanding the effects of management practices on soil quality is essential for evaluating the sustainability of biofuel intercropping in existing timber stands. Microinvertebrates have been evaluated as indicators of soil quality due to the key role that they play in decomposition and nutrient cycling in soil ecosystems. This study concentrated on using soil microinvertebrates as bioindicators for quantifying changes in soil quality in response to intercropping loblolly pine and switchgrass in a set of experimental plots (Lenoir, NC; study funded by Catchlight Energy). Samples were collected from three treatments: pure switchgrass, pine, and intercropped pine-switchgrass. We divided the plots into six quadrants and collected soil core samples from the center of each quadrant. A Berlese-funnel system was then used to extract microinvertebrates from soil cores by increasing the temperature from 72°F to 140°F over five days. Microinvertebrates were identified to the level of morphotaxa. Differences in community structure in different treatments were evaluated using a combination of diversity indices and ordination (PCA). Identification of potential indicator species was then determined using Indicator Species Analysis, a statistical approach that integrates the abundance and fidelity of a taxa into a single metric. This paper evaluates changes in community structure in response to treatment and seasonality in order to help determine appropriate indicator species for monitoring changes in soil quality.

Effects of nutrient deficiency on the mechanism of the Rack-1 gene in *Arabidopsis thaliana*

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Arabidopsis thaliana is a model organism that is a member of the Brassicaceae family. It completes its life cycle in as little as six weeks, flowering in three weeks. These self-pollinating plants can be cultivated in the lab via Petri plates or pots, under fluorescent lights or in a greenhouse. The receptor for activated C-kinase 1 (RACK1) is a highly conserved WD40 repeat scaffold protein found in *A. thaliana*. RACK1 is ubiquitously expressed and has been implicated in diverse signaling pathways involving neuropathology, cellular stress, protein translation, and developmental processes. RACK1 has established itself as a scaffold protein through physical interaction with a myriad of signaling proteins ranging from kinases, phosphatases, ion channels, membrane receptors, G proteins, IP3 receptor, and with widely conserved structural proteins associated with the ribosome. In *Arabidopsis thaliana*, RACK1A is implicated in diverse developmental and environmental stress pathways. Despite the functional conservation of RACK1-mediated protein-protein interaction-regulated signaling modes, the structural basis of such interactions is largely unknown. Here we present significant findings in the area of nutrient deficiency response in *A. thaliana.* The results indicate that *RACK*1 is activated by environmental stressors such as sugar, phosphate, and nitrate and other nutrients that play a critical role in fitness when present in abnormal concentration.

The interaction between invasive tree *Ailanthus altissima* and native *Robinia pseudoacacia* in eastern deciduous forest

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Native plant populations, communities and ecosystems are fundamentally impacted by interactions between native plants and non-indigenous invasive plants. This research focuses on understanding the extent and mechanism of interaction between non-indigenous invader *Ailanthus altissima* and *Robinia pseudoacacia,* a functionally similar native to the Appalachian region. A field plantation was established at the Blandy Experimental Farm, VA, to test inter- and intra-specific competition. The hypotheses tested are: 1) *A. altissima* will be the winner in competition with *R. pseudoacacia*; 2) The presence of insects (Locust leaf miner and Ailanthus webworm) will influence competition output. Height and basal diameter of all plants were measured, and additional plants were harvested for dimension analysis. In a linked community survey, trees, saplings and seedlings were mapped in three types of 20×50m plots to address spatial distribution of these two species in early successional forest. The growth of *A. altissima* tended to decrease as density increased in monocultures, but *R. pseudoacacia* growth had the reverse relationship. *A. altissima* grown with *R. pseudoacacia* tended to be larger than plants in monoculture, suggesting *R. pseudoacacia* facilitated *A. altissima* growth. *Ailanthus altissima* had no negative effect on *R. pseudoacacia* after one growing season. Both *A. altissima* and *R. pseudoacacia* had a greater increase of biomass in sprayed plots compared with plants in unsprayed plots, but did not influence the competition result. The two subject species were not significantly clustered in early successional plots. However, *A. altissima* seedlings were associated more with *R. pseudoacacia* trees than other dominant trees.

The use of probiotics to prevent a lethal disease in the iconic Panamanian golden frog

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Populations of native Panamanian golden frogs (*Atelopus zeteki*) have collapsed due to a recent chytridiomycosis epidemic. Reintroduction efforts from captive assurance colonies are unlikely to be successful without the development of methods to control chytridiomycosis in the wild. In an effort to develop a protective treatment regimen, we treated golden frogs with *Janthinobacterium lividum*, a skin bacterium that has been used to experimentally prevent chytridiomycosis in North American amphibians. Although *J. lividum* appeared to colonize *A. zeteki* skin temporarily, it did not prevent or delay mortality in *A. zeteki* exposed to *Batrachochytrium dendrobatidis,* the causative agent of chytridiomycosis. Current research efforts are focused on isolating and testing antifungal bacterial species from Panama that may be more compatible with *Atelopus* skin. Approximately 560 cultures of bacteria were isolated from the skin of nonsusceptible Panamanian amphibian populations at locations where *B. dendrobatidis* is endemic. Approximatley 10% of these bacteria killed *B. dendrobatidis in vitro*. I am currently examining whether a subset of these bacteria can persist on golden frog skin and prevent chytridiomycosis. I hope the results of these findings will contribute to the long-term conservation of this iconic species.

Regenerative stream conveyance (RSC) as an approach to restoration of ecosystem services

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Many zero, 1st and 2nd order channels have been degraded by urban runoff. In addition to the sediment and nutrient loading, their degradation has resulted in the reduction of important habitat as well as ecosystem services. The use of stream and wetland restoration techniques, applied with a focus towards enhancing/restoring ecosystem function, suggests we can make significant positive contributions to the quality and quantity of our coastal resources and improve the quality of life in our local communities. In ephemeral or intermittent drainage channels, this approach includes the use of a carbon-rich granular substrate (e.g., sand to gravel with 20% V:V shredded wood) to fill the eroded channel, a series of constructed pools and riffle weirs to provide non-erosive conveyance, and on-grade seepage wetlands to capture and treat the pulsed storm water runoff. In perennial streams, the incised stream channel is raised (where feasible), to reconnect peaky urban discharges to the adjacent riparian/floodplain corridor through the placement of boulder and riffle grade controls. In addition, riparian/floodplain storage is increased through the construction of on-grade seepage wetlands. To date, monitoring and research have documented the positive effects on urban hydrology (i.e., reduced peak discharge, increased flow concentration time), water quality (i.e., sediment and nutrient discharge load reductions), habitat (e.g., species diversity and density), quality of life (e.g., increased useage), as well as other metrics of ecosystem services (e.g., groundwater supply). Generally, this ecological engineering approach costs a fraction of the standard engineering approach (i.e., drop structures, pipe, concrete outfalls).

The effect of saltwater intrusion on microbial community structure and function in a tidal freshwater marsh

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Sea level rise is a climatic stressor that has a unique impact on tidal freshwater wetlands. It causes saltwater intrusion into environments historically dominated by freshwater flows, where even modest increases in salinity can adversely affect plant community composition and productivity, and potentially change ecosystem-scale carbon dynamics. In addition, microbial activity in the wetland soils may also be affected because the influx of sulfate offers a new substrate for anaerobic microbial respiration, shifting redox conditions and changing pathways of carbon mineralization. The objective of this research was to determine microbial community responses to elevated salinity associated with a long-term field study in a tidal freshwater marsh in South Carolina, where *in situ* manipulation consistently raised porewater salinities from freshwater to oligohaline levels (~2-5 ppt).

At the end of the three-year field manipulation, soil cores were collected and extracellular enzyme assays (EEA) were performed for several labile (β-1,4-glucosidase and 1,4-β-cellobiosidase) and recalcitrant (β-D-xylosidase, phenol oxidase, and peroxidase) components of the soil carbon pool. Saltwater addition did not have a consistent effect on EEA of the labile substrates, but activity decreased dramatically for the more recalcitrant substrates. For example, the activity of phenol-oxidase in the saltwater-added plots was 10-20% of the activity in the control plots. This could be important due to potential long-term effects on net carbon storage in wetlands. These changes in microbial activity were coincident with changes in microbial community structure as assayed using whole-community DNA fingerprinting (T-RFLP). Combined with the observed changes in biogeochemical rate measurements describe elsewhere, this research demonstrates a link between community structure and function.

Female age and caterpillar frass abundance correlate with annual fecundity in the Prothonotary Warbler (*Protonotaria citrea*)

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For short lived species such as migratory songbirds annual fecundity is an important factor limiting populations. For example, in multiple brooding species, the proportion of individuals that successfully rear more than one clutch significantly impacts annual fecundity. Factors such as temperature, age, and food availability have been found to correlate with double brooding, but few studies have addressed these relationships. Prothonotary Warblers (*Protonotaria citrea*) are facultatively double brooded and we have monitored their reproduction in riparian habitat along the James River, Virginia for more than 15 years. Recently, food availability was measured indrectly through the collection of caterpillar feces (frass). The proportion of older females and the magnitude of the peak in frass abundance appear to be positively correlated with the rate of double brooding, but our sample size is small for frass collection years. The timing of the peak in frass abundance also appears to have an effect on double brooding rates. We are currently assessing more specifically how each of these factors affect annual fecundity in this species.

Effects of biopesticides on oviposition in both introduced and native mosquito species

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Introduced species are those non-native to a region whose establishment can cause ecological or economic harm. For example, Asian tiger mosquitoes (*Aedes albopictus*) represent a significant health risk to both humans and wildlife as they can transmit numerous viral diseases. How biopesticides induce larval mortality is well researched, and their use dominates current attempts to control introduced mosquito populations globally. These control programs are based on a critical assumption that females have no ability to detect pesticides at breeding sites and thus freely lay their eggs in treated areas. *W*e tested how *introduced (A. albopictus and A. japonicas) and native (Culex restuans*) female mosquitoes responded to the presence of *Bacillus thuringiensis israelensis* (BTI), *Bacillus sphaericus (BS), their combination and controls lacking biopesticides at experimental breeding sites. Female A. albopictus* laid significantly fewer eggs in sites with any biopesticide in contrast to *A. japonicas* who showed no response and *C. restuans* who laid significantly more egg rafts when any biopesticide was present. These species specific responses reflect local patterns of abundance and might provide a behavioral mechanism explaining the successful establishment of introduced disease vectors.

The genotoxicity of atrazine in the cnidarian *Hydra magnipapillata*

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Previous mutagenicity studies of atrazine (an agricultural herbicide) indicate that the compound is genotoxic, although results are highly variable and dependent on the taxonomy of the study organism and the assay used. Here we measured the genotoxic effects of atrazine on the freshwater cnidarian, *Hydra magnipapillata*. *Hydra* were exposed to eight concentrations of atrazine representing a range of ecologically relevant and extreme doses (0, 0.003, 0.01, 0.1, 2.5, 10, 20, and 30 ppm) for 96 hours and then the comet assay was used to assess DNA damage. Tail Moment (an indicator of DNA damage) was assessed for approximately 6,700 nuclei from animals across all treatments. We found that atrazine concentration has a surprisingly non-linear relationship to DNA damage. The highest levels of DNA damage occurred at the mid-range test concentrations (0.1 and 2.5 ppm) producing tail moments 2-2.5 times control levels. The highest concentrations (10, 20, and 30 ppm) and one of the lowest concentrations (0.01 ppm) had the next-highest tail moments, approximately 1-1.7 times the control. There was no difference in tail moment between the control and the 0.003 ppm concentration. These results suggest that two or more mechanisms of DNA damage may be involved, and that further research is needed to elucidate these mechanisms.

Timing of gamete release in the ctenophore *Mnemiopsis leidyi*

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The ctenophore *Mnemiopsis leidyi* dominates coastal food webs in their native western Atlantic and as an invasive species in the Black, Caspian, North, and Baltic seas. These simultaneous hermaphrodites release sperm and eggs daily, although the exact timing for gamete release has not been methodically investigated. During the summer of 2011, we collected *M. leidyi* from Barnegat Bay, NJ and conducted experiments to explore the presence of extrinsic spawning cues by analyzing times of peak gamete release, initiation of gamete release, and the correlation of sperm and egg release over the course of the night and early morning. Samples were collected at various hours (1, 3, 5, and 8) after the onset of darkness, as well as one hour after sunrise (+1). While the number of individuals releasing eggs remained relatively constant throughout the night, more individuals began releasing sperm as the night progressed. Based on egg and sperm peak releases, it appears that the greatest numbers of both gametes are released after eight hours of darkness. This overlap in the timing of sperm and egg release may favor self-fertilization over out-crossing. While self-fertilization may limit genetic diversity, it could enable the establishment of an invasive population by a small number of individuals.

Altering college students' misconceptions of evolution requires addressing views that evolution and religion are in conflict

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Several studies have implicated that religious belief and political leanings are correlates of acceptance of evolution; however, relatively little research has explored how students' attitudes towards evolution influence their learning. We surveyed 77 students about their knowledge of and attitudes toward evolution at the beginning and end of an introductory biology course. We hypothesized that students who held the view that science and religion are in conflict would see less gains in evolutionary knowledge than student who viewed science and religion as compatible. Initial scores for correct evolutionary knowledge were relatively high (77% correct) at the beginning of the term and did not significantly change after a semester of instruction (78%, $p>0.1$) while students' misconceptions of evolution marginally, but significantly, decreased (pre: 55 vs. post: 52; $p=0.02$). There was a decrease in agreement with opinion statements that contradict evolutionary fact ($p<0.001$) and a marginal decrease in the view that science and religion are in conflict ($p=0.06$). In a stepwise multiple regression, change in students' misconceptions was explained by pre-term misconceptions ($\beta=-0.84$, $p<0.001$), post-term science/religion conflict attitudes ($\beta=0.505$, $p<0.001$), and post-term opinions inconsistent with evolutionary fact ($\beta=0.44$, $p<0.01$). Questions that were most highly positively correlated with end term misconceptions included 'I am afraid to study science because it opposes by my faith' ($p<0.001$, $r=0.64$) and 'People who accept evolution are not moral' ($p <0.0001$, $r=0.67$). These results suggest that directly addressing students' concerns evolution conflicts their faith may lead to greater reductions in evolutionary misconceptions and increases in correct evolutionary knowledge.

Pre- and post-zygotic reproductive barriers between two host-plant complex races of a parasitic wasp

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Understanding the mechanisms of speciation and reproductive isolation has important implications for studies in biodiversity, evolution, and ecology. Insect parasitoids in particular display rapid speciation that may be associated with differential host species or chemically diverse host plants. Investigations of host-associated differentiation of parasitoids have largely focused on the degree of molecular genetic differentiation, but a true test of species status must consider whether differentiated populations are capable of interbreeding and producing viable offspring. We examined possible mechanisms of isolation between two genetically distinct host-plant complex races of the parasitoid, *Cotesia congregata* (Hymenoptera: Braconidae), originating from *Manduca sexta* on tobacco or *Ceratomia catalpae* on catalpa. Comparisons of male responses to female pheromones, elements of male acoustic courtship signals, and mating success between the two groups were made to test for pre- and post-zygotic isolation. Males showed a ~30% decreased response to female pheromone of the reciprocal race and male courtship songs showed significant albeit subtle differences in duration, frequency, and amplitude. Despite these differences, wasps from the two sources mated and produced offspring, suggesting that factors other than courtship behavior may be involved in pre-zygotic isolation of the two races. However, 90% of females from one hybrid cross failed to produce offspring, leading to post-zygotic isolation. Development time, emerged brood size, and sex ratios among the wasp races also differed. Results suggest that the two host-complex races represent incipient species.

A forestry reclamation approach for surface mines in the Appalachian region

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With the implementation of the Surface Mining Control and Reclamation Act (SMCRA) in 1977, grassland reclamation became the dominant reclamation approach that persisted for 30 years in the Appalachian region. As stakeholders of the reclamation process began to appreciate the value of forest ecosystems and the consequences of their loss, there is now a greater emphasis on reforestation and restoring ecosystem services. We developed a forestry reclamation approach consisting of (1) the selection of soil and overburden materials for tree growth media; (2) the placement of these materials to a depth and consistence to maximize forest productivity and diversity; (3) the selection of tree-compatible ground cover for erosion control; (4) planting the mined site with silviculturally-compatible mixes of native trees; and (5) developing planting procedures specifically for reclaimed mined sites. This approach has been adopted by the mining community as "best reclamation practice" for restoring the native forest. Outcomes include establishment of several thousand hectares of new, native forests on mined sites, better water infiltration and restoration of hydrologic function, and greater plant and animal diversity on reclaimed mined land. The evolution of this forestry reclamation approach, and our current work on a more comprehensive ecosystem reclamation approach that would include geomorphic landform design and reconstructed streams, will be described.

Timing of disturbance alters gall-making arthropod abundance as well as goldenrod biomass and height in old field habitat

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Disturbance is an important part of maintaining old fields in order to prevent them from growing into forests. The timing of mowing disturbance may not only affect the diversity of plants, including the density of the dominant goldenrod (*Solidago altissima*), but may also effect gall-making arthropods, which overwinter in the goldenrod. An experiment was conducted to evaluate the effects of changing mow time to early spring. We created 2 blocks each of fall and spring mow and tracked the plots over 2 years (2010-2011). At four points in each block we measured gall density, as well as goldenrod biomass, reproductive output, and height. Mow time had no effect on reproductive output or density of goldenrod. The fall-mow blocks had significantly greater biomass ($p<0.001$) and gall density ($p<0.001$) than spring-mowed plots. There was a significant interaction between year and mow time on both biomass and gall density ($p<0.001$; $p<0.018$), which indicated that the better climatic conditions of 2011 amplified the effects of mow time. Fall-mow plots were taller, as were plants in 2011 ($p=0.007$; $p<0.001$); however the interaction was not significant. In terms of effect of galls on plants, results showed that galls negatively affected reproductive output ($p<0.001$), but had no effect on biomass. Contradictory to our hypotheses, fall mow benefited the gall-making arthropods better than the proposed spring mow. However, spring mow may decrease biomass and height of goldenrod which are dominant in the field. This could have implications for plant diversity.

Comparison of soil carbon dynamics in residential lawns and unmanaged forest

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Conversion of native forests to turfgrass-dominated residential landscapes under a wide range of management practices results in dramatic changes to vegetation and soils, which may affect soil carbon storage. To better understand the effects of landscape conversion and management on soil carbon, we studied 64 residential properties in southwest Virginia to compare turf grass landscapes and the surrounding hardwood forests from which they were developed. Soil data (Carbon, Nitrogen, Bulk Density, CO_2 efflux) was collected from lawns and adjacent forest stands to a depth of 30 cm in addition to site measurements. Total soil carbon content to 30 cm depth of lawn (6.5 kg C/m^2) and forest (7.1 kg C/m^2) marginally differed (P=0.08); however, lawn soil contained significantly greater C than forest soil at the 20-30 cm depth (0.010 vs. 0.007 g C/cm^3, P=0.0137). We found a positive relationship between time since development and percent C of lawn at the 0-5 cm depth (P=0.04), whereas there was a negative relationship with percent C at the 20-30cm depth (P=0.03). Based on the homeowner survey, we found a positive correlation between lawn fertilization frequency and both lawn nitrogen density (P=0.07) and lawn carbon density (P=0.0005) in the top 0-5 cm of soil. Our results indicate that converting unmanaged Appalachian hardwood forest into managed, turf-grass dominated residential homesites results in similar carbon concentration as the previous forest.

Disturbance-dependent species area relationships in riverine rock pool communities

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The species-area relationship (SAR) is a fundamental ecological pattern. Determining the factors shaping this relationship is critical for understanding patterns of biodiversity across communities. MacArthur and Wilson's equilibrium theory of island biogeography (ETIB) provides a conceptual framework for identifying factors shaping SARs. The ETIB posits that larger patches will have higher immigration and lower extinction rates and therefore support more species. Factors that affect immigration and extinction rates independently of area may weaken this relationship. We extend MacArthur and Wilson's ETIB by including disturbance-driven shifts in both extinction and immigration rates, and test these ideas within a system of isolated rock pools that experience frequent flooding. We propose that flooding may increase immigration of riverine taxa into isolated pools and increase extinction rates by washing taxa from pools. Both of these effects will weaken the SAR but result in different taxa abundances. We examined SARs in a system of 35 rock pools on the James River in Richmond, Virginia, before and after a flooding event. We generated species accumulation curves and estimate asymptotic species richness for 19 pools before and 16 pools after flooding. We sampled 3162 individuals from 47 different taxa, and estimated pool richness ranged from 2.5 to 27.4 taxa. As predicted, flooding reduced the strength of the SAR. The observed weakening of the SAR was largely driven by increased extinction rates of taxa with complex life cycles rather than increased colonization of riverine species.

Synthesizing studies of plastic responses to pond drying in amphibians: a meta-analysis

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Phenotypic plasticity allows organisms to respond to environmental change and persist in unpredictable environments. Amphibians reproduce in ephemeral environments and can display phenotypic plasticity by accelerating development to escape drying ponds. Despite more than 20 years of research on the effects of pond drying on amphibian development, these studies have not been quantitatively synthesized. We compiled 30 studies which directly manipulate water levels in experimental venues. From each study, we calculated effect sizes as the log response ratio on time, size and survival to metamorphosis. We ask whether responses to pond drying are related to phylogeny, experimental venue, tadpole density, and taxa specific variation in life history traits. Amphibian taxa vary in their response to pond drying, with leiuperids, hylids and ranids exhibiting larger proportional reductions in larval duration in response to dry down treatments than bufonids and pelobatids. These differences may be attributed to variation among experimental methods and/or in life history traits. Across taxa, faster drying rates resulted in larger reductions in larval period, supporting the idea that reductions in vertical swimming volume may act as an important cue for pond drying. Species with relatively fast development rates under constant water conditions exhibited weaker proportional response to drying compared to taxa with longer larval duration. Many taxa emerged earlier with no apparent cost in size or survival. This synthesis contributes to our understanding of how life history and phylogeny may impact the ability of species to plastically respond to changing climatic conditions.

Relation of microbial biomass carbon and tree root distribution to soil carbon dynamics four years after urban soil rehabilitation

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Urbanization typically results in degraded soils, making soil rehabilitation to improve structure and function over time desirable. This study evaluates the potential of soil rehabilitation to enhance the regenerative capacity of degraded urban soils by altering the soil microbial community, tree root distribution, and soil carbon dynamics. In 2007, four treatments were applied to soil pre-treated by topsoil stripping and grading to mimic typical land development. Treatments were: typical construction practice (10 cm topsoil replaced), enhanced practice (10 cm topsoil replaced plus rototilling), urban soil rehabilitation via profile rebuilding (compost 21amendment incorporated via subsoiling to 60-cm depth, 10 cm topsoil replaced plus rototilling), and undisturbed (no pretreatment and no improvement methods). All plots were planted with five species of trees. In June 2011, we measured microbial biomass carbon (MBC), root length, and soil carbon pools 1 m from *Acer rubrum* trees at 0-5 cm, 5-10 cm and 15-30 cm depths. Soils subjected to profile rebuilding had greater MBC (149.47 mg C/kg soil) than other treatments (ranging from 40.36 -90.53 mg C/kg soil) at the 15-30 cm depth, but there was little difference between treatments at shallower depths. Soil profile rebuilding altered vertical root distribution with mean total root length increasing with soil depth (74.68, 108.50, and 380.29 cm at 0-5, 5-10, and 15-30-cm depths, respectively). Root length decreased with soil depth under typical construction practices. Urban soil rehabilitation improved microbial community and tree root development in subsoil. Relationship to soil carbon pools and aggregate size distribution are discussed.

Maternal transfer of mercury in the northern watersnake (*Nerodia sipedon*): Effects on offspring performance, and learning

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Few studies examine contaminants, such as mercury (Hg), in snakes, much less maternal transfer and effects, despite snake abundance and their high trophic position in ecosystems where Hg is prevalent. The objectives of this study were to determine if Hg is maternally transferred in northern watersnakes (*Nerodia sipedon*) and evaluate effects of maternal Hg on offspring. We captured gravid female watersnakes (N=31) by hand along the South River in Waynesboro, VA, where an extensive Hg contamination gradient exists. We measured maternal Hg levels using non-lethal sampling techniques and following birth, assessed terrestrial and aquatic locomotion, foraging ability (ie., prey eaten, strike efficiency, handling time), and learning (i.e., improvement in foraging measures over successive trials) in their offspring (N=609). Preliminary results suggest that maternal transfer of Hg does occur in *N. sipedon*, but no significant effects of maternal Hg were observed on locomotion. However, offspring from mothers with high Hg exhibited reduced willingness to feed in foraging trials and decreased strike efficiency. All litters showed a decrease in strike efficiency throughout learning trials, but offspring from the contaminated site were consistently worse. This is the first study on maternally derived contaminant effects in snakes and will contribute to understanding this contaminant exposure pathway in wildlife. This study will also aid conservation and remediation efforts at the South River, where northern watersnakes are common and likely play important roles as ecosystem components.

Metabolic response of the freshwater mussel *Pyganodon grandis* to alterations in temperature and photoperiod

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Metabolic rate determines how much energy input is required for organismal maintenance, growth, and reproduction. On a community scale, metabolic rate also influences an organism's environment by removing and returning resources through uptake of nutrients and excretion of wastes. Due to their role as filter feeders, the metabolic rates of freshwater mussels may have a strong impact on water quality, as suggested by studies on invasive bivalves including zebra mussels (*Dreissena polymorpha*) and Asian clams (*Corbicula spp.*). Human activity, in turn, has been indicated to have significant impact on mussel metabolic rate through alterations in such metabolism-altering factors as suspended solid load, temperature, dissolved oxygen concentration, habitat availability, and nutrient load. In this study, we examined the combined effect of temperature and photoperiod on metabolic rate of the freshwater mussels *Pyganodon grandis* in order to elucidate how both natural, seasonal alterations and human-induced alterations impact these organisms and, consequentially, their environments. This was achieved by acclimating mussels to one of nine temperature-photoperiod combinations in a 3x3 experimental design with n= 5 mussels per treatment. Metabolic rates were measured individually after two weeks of acclimation using fully-automated intermittent flow respirometry. Data were then normalized for soft tissue mass, and differences in metabolic rates in response to temperature and photoperiod are analyzed using ANOVA. The impacts of incongruence between temperature and photoperiod regimes found in nature were considered.

Innovative mesocosm design to investigate the impacts of ocean acidification on carbon cycling in coastal waters

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Ocean acidification, caused by increasing pCO_2 concentrations in the ocean, is a growing concern among today's scientists. It is unknown how this increase in pCO_2 and subsequent decrease in pH will impact marine biogeochemical processes, in particular the microbial loop and biological pump. The term "biological pump" refers to the algal mediated uptake and fixation of CO_2 in the surface ocean and the subsequent sequestration of this organic carbon in the deep ocean. This pump has been primarily studied in large mesocosms, positioned at fixed locations, thus prohibiting comparative investigations across varying environmental regimes. The primary objective of this research was to construct 50L mesocosms that maintained predicted pCO_2 concentrations (1000 ppm) and follow the progress of a nutrient induced coastal phytoplankton bloom. The pCO_2 of the water was manipulated and regulated through the headspace, thus mimicking atmosphere-surface water interactions more accurately than constantly bubbling gas mixtures. The microbial processing of algal derived carbon was traced by monitoring bacterial production and respiration, DOC concentrations, particulate C and N concentrations, Chlorophyll *a*, and calculation of bacterial growth efficiency. Results from a six day experiment suggested a slight increase in primary production as well as an increase in bacterial respiration in the elevated (1000 ppm) mesocosms when compared to the ambient mesocosms. This experiment identified a successful method for studying the coastal biological carbon pump as well as helped elucidate the consequences of ocean acidification on the coastal biological carbon pump.

Assessing carbon processing differences in environmentally varied aquatic mesocosms: results from the carbon awareness partnership (CAP) program at the VCU Rice Center

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Respiration and photosynthesis have been extensively studied as primary regulators of the carbon cycle in terrestrial environments but are less understood in aquatic systems. This is partially because the lability of allochthonous and autochthonous organic matter is debated on both local and regional scales. At VCU's Rice Center in the fall of 2011, 60 Virginia high school students worked in collaboration with VCU researchers as part of the *CAP* program to investigate carbon processing in experimental mesocosms embedded in differing environments. Students collected field measurements and set up a laboratory experiment to test the following hypotheses they created: H_1:) Carbon consumption within a forested mesocosm would significantly increase after autumn leaf fall, H_2:) Carbon consumption in a mesocosm fully exposed to the sun would be significantly higher than in a forested mesocosm, and H_3:) A forested mesocosm would have lower chlorophyll *a* (chl*a*) and higher pCO_2 concentrations than a mesocosm in full sun. The first and third hypotheses were confirmed: carbon consumption was significantly higher after leaf fall in the forested mesocosm (t-test=4.78,df=4), and chl*a* was higher and pCO_2 was lower in the sun exposed mesocosm than in the forested mesocosm. However, the second hypothesis was not supported (t-test=0.92,df=4). These results suggest that the forested mesocosm is dominated by terrestrial inputs of carbon and associated bacterial metabolism (respiration), while the sun exposed mesocosm is dominated by primary production (photosynthesis). Further, our results indicate no significant difference in carbon consumption derived from autochthonous or allochthonous inputs.

Long-term carbon and nutrient accrual in coal mine topsoil substitutes in southwest Virginia

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Topsoil substitute selection is fundamental for the long-term success of reclamation efforts to restore native vegetation to the post-mining landscape in the Appalachian Coal Region. Topsoil substitutes created from overburden are required as a result of the absence of natural topsoil or the inability to conserve topsoil during mine development. Thirty years of research on the Controlled Overburden Placement Experiment at the Powell River Project in Wise County, Virginia is used to evaluate the status of soil carbon and nutrient accumulation and retention in reclaimed mine soils under forest and herbaceous vegetation over a gradient of topsoil substitutes. Topsoil substitutes range from pure sandstone (SS) to pure siltstone (SiS) and include ratios of 1:2, 1:1, and 2:1 SS to SiS mixes. Soils were analyzed for total carbon, total nitrogen, organic carbon, available phosphorous, and particle size. Results show carbon and nutrient concentrations are related to changes in SS:SiS ratios under forest vegetation; however, some nutrient contents did not vary between rock mix types. Results indicate that different topsoil substitutes have different capacities for soil carbon and nutrient accumulation, which can be related to vegetative cover. Comparison of carbon and nutrient characteristics in reclaimed soils to present-day, adjacent, unmined soils have been explored and provide insight into the carbon and nutrient development and topsoil substitutes trajectories. Choice of overburden rock type may differentially affect the success of revegetation and some ecosystem services (e.g., C-sequestration and nutrient availability), including the timeframe in which these services can be returned to the post-mining landscape.

Changing flora of the Richard Stockton College campus, 1970-2012

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In 1970, before construction began at newly-founded Stockton State College in Galloway Township, New Jersey, Jack McCormick, a noted student of the Pine Barrens, was commissioned to conduct an ecological inventory and make recommendations for preserving the pinelands character of the 1586-acre campus site. He recommended such steps as eschewing the use of non-native turf grasses in favor of species native to the Pine Barrens and the stockpiling of shrub turf from cleared forest tracts to use in restoration. His report contains a detailed list of the plant species then growing within the campus boundaries. In 2009, in connection with revision of the College's master plan, a survey was carried out that again listed the plant species found on the campus. In 2010 and 2011, students for the spring semester Ecological Principles Lab and the fall semester Environmental Issues Lab classes at Stockton, as part of a study of exotic invasive plant species, compiled the lists from 1970 and 2009 for comparative study. Ecology students are continuing the investigation in 2012, developing GIS maps to indicate the shifting character of the vegetation and flora of the campus, under the combined effects of fire suppression, mowing, soil compaction from vehicles and humans, and the introduction and spread of exotic invasive species. The results show that the College has to date failed in its stated goal of maintaining the essential character of the NJ Pinelands in the development of its campus

Does stem length affect physiology and hydraulic conductance in pole bean?

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The field of plant physiology has recently looked to water transport in trees to explain apparent constraints on tree height and growth (referred to as the hydraulic limitation hypothesis), but whether those same dynamics are at work in herbaceous vines is relatively understudied. We measured the conductance and morphological properties of the pole bean, *Phaseolus vulgaris*, over the course of several months and under varying nutrient regimes, to determine how the height of the vine and access to nitrogen affected its hydraulic properties and structural development. In both treated and control plants, whole plant hydraulic conductance and total leaf area increased with shoot length, contrary to the hydraulic limitation hypothesis. Plants given treatments of nitrogen fertilization showed an overall reduction in stomatal conductance and transpiration while sustaining an increased leaf water potential gradient. However, photosynthesis was not significantly different between either the control or treated plants. We suggest that overall, pole beans, at least, are not hydraulically constrained in the same way as woody plants. Fertilization, however, causes an increase in water use efficiency without a change in the hydraulic property of the stems. This is likely the result of the increased supply of nitrogen increasing photosynthetic capacity per unit leaf area.

Comparative reproductive traits of two competing invasive species of crayfish (*Orconectes rusticus* and *Orconectes virilis*) in the Monocacy River

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Our research characterized female reproductive traits of two competing invasive crayfish species, *Orconectes rusticus* and *Orconectes virilis*, in the Monocacy River. Both species are invasive in this system but *O. rusticus* is presently displacing *O. virilis* and reproductive traits may contribute to their competitive advantage. We determined potential and actual fecundity, average egg weight, total reproductive biomass, and percent maturity. *Orconectes rusticus* exhibited lower potential and actual fecundity than *O. virilis* but they had greater average egg weight. Both species exhibited a similar relationship between total reproductive output and size. *O. rusticus* females became mature at a smaller size than *O. virilis*. The results presented here suggest that *O. rusticus* exhibited a K-type reproductive strategy in producing a smaller number of large eggs, relative to the r-type strategy exhibited by *O. virilis* in producing a larger number of small eggs. These differences may provide a competitive advantage to *O. rusticus*, as smaller size at maturity could potentially lead to increased population fecundity, and the production of higher energy eggs may confer increased starvation resistance and growth rate among juveniles.

Vegetative recruitment patterns and seed bank composition in a recently restored mixed tidal regime wetland

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Ecological restoration of a prior converted wetland was characterized within a recently drained impoundment along the James River, Virginia. We quantified the recruitment and colonization of native and non-native wetland vegetation within a former impoundment using GPS/GIS technology. Colonizing vegetation was assessed over three growing seasons in both tidal and non-tidal environments. Objectives for this study were (1) to examine geospatial relations of recruitment patterns among colonizing species over two growing seasons, (2) assess geospatial distribution of invasive species, (3) quantify species composition in the extant seed bank and (4) assess geospatial patterns in recruitment of bald cypress (*Taxodium* distichum L.). The two most common native colonizing species during 2009, 2010 and 2011 growing seasons were narrow-leaf cattail (*Typha angustifolia* L.) and rice cutgrass (*Leersia oryzoides* L.). The two most common exotic invasive species were asian spiderwort (*Murdannia keisak* Hassk.) and Japanese stiltgrass (*Microstegium vimineum* Trin.). We determined that narrow-leaf cattail and Asian spiderwort were the most dominant species in tidal portions of the basin. In non-tidal portions of the basin fewer invasive species were present and rice cutgrass tended to dominate vegetative communities. Differences were observed between extant species and the seed bank across all habitats. Two hundred and eighty-one bald cypress individuals have been located within the restored wetland. Over 75% of the individuals found were seedlings or saplings. Based on geospatial relations of these recruits we have identified potential areas within the restored wetland for natural and facilitated bald cypress recruitment.

Alkaloid levels in leaves of *Lobelia cardinalis* from two Pennsylvania sites

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In plants, the synthesis of secondary metabolites can be influenced by both genetic and environmental factors. While manufactured as by-products of important metabolic processes, some of these phytochemicals have proved useful to humans pharmacologically and to the host plants themselves as defense compounds against pests and pathogens. Cardinal flower (*Lobelia cardinalis*) produces a suite of one class of secondary compounds, alkaloids, dominated by lobeline.

To compare alkaloid concentrations at the population level, *L. cardinalis* plants in two locations were chosen for investigation: Schenley Park in Pittsburgh, PA and Powdermill Nature Reserve in Rector, PA. Population parameters such as soil characteristics, population density, floral display traits, and seed weevil damage were recorded throughout the growing season. Using a microwave-extraction technique, we stained leaves for alkaloids, digitally processed the images into grayscale, and digitally sampled for average alkaloid concentration in both older and younger leaves at the two sites.

Powdermill and Schenley differed in plant density, weevil infestation, and carbon and nitrogen content, but not C:N. Powdermill had significantly more flowers per stem ($F_{2,231} = 120.85$, $p<0.001$) and significantly more flowers per plant ($F_{2,43} = 30.19$, $p<0.001$) yielding larger floral displays in Powdermill's more distributed population. Weevil infestation varied from zero weevils in an entire plant to single capsules holding three adult weevils, and Powdermill plants had greater weevil infestation ($F_{2,455} = 32.35$, $p<.001$). Alkaloid analyses are ongoing, but early indications are that Powdermill plants produced more alkaloids, challenging the concept that the alkaloid mixture in *L. cardinalis* deters its seed predator.

Characterization of naturalized populations of *Miscanthus sinensis* in highly disturbed environments

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Miscanthus sinensis is a C4 perennial grass native to the grasslands of Japan, China and Eastern Russia. It was originally introduced to the United States in the late 19th century at the historic Biltmore estate as an ornamental plant. It remains a very popular ornamental grass, with annual sales exceeding $39 million dollars in North Carolina as of 2008. Due to its low maintenance requirements, cold tolerance, and high biomass potentials it has been under evaluation as a candidate biofuel crop. Over the past 100 years, naturalized populations of *M. sinensis* have spread across the eastern US, especially along the Appalachian Mountain corridor. In order to fully assess the invasion potential of this species we must characterize its naturalized range in the United States. This study surveyed 20 naturalized populations of *M. sinensis* across the northeastern corridor of the US spanning from Tennessee to Maine. We collected demographic as well as environmental data. Nearly all populations were located in low value, high disturbance areas such as roadsides, highways, railroads, power line right-of-ways as well as abandoned gardens and nurseries. Population sizes ranged from 15 individuals to thousands. Analysis of these populations shows increase in biomass from north to south as well as indiscriminate soil requirements. Also, a survey of satellite populations surrounding large populations shows potential for long distance dispersal greater than previously observed. Characterization of these populations is integral if *M. sinensis* is implemented as a bioenergy crop.

Factors influencing inter- and intra-specific variation in mercury bioaccumulation by snakes inhabiting a contaminated river floodplain

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Although recent recognition of global reptile declines has led to a new-found enthusiasm in reptile conservation, snakes remain one of the most understudied vertebrate groups. Environmental contamination has been proposed as a major threat to reptiles, and snakes may be particularly susceptible because they are long-lived and feed at high trophic levels. Mercury (Hg) is a notable contaminant because of its widespread distribution, toxicity to humans and wildlife, and its ability to bioaccumulate and biomagnify within food webs. Although there have been many studies examining Hg in fish, birds, and mammals, knowledge about Hg accumulation in snakes is limited. In this study we aimed to shed light on the factors that put snakes at risk of Hg contamination by examining several snake species from a historically Hg contaminated river floodplain in central Virginia. Specifically, we used nonlethal sampling techniques to evaluate Hg bioaccumulation within and among four snake species: northern watersnakes (Nerodia sipedon; N = 124), queensnakes (Regina septemvittata; N = 9), black rat snakes (Elaphe obsoleta; N = 10), and eastern garter snakes (Thamnophis sirtalis; N = 7). We examined tissue Hg concentrations in relation to snake demography (sex and body size), feeding ecology (indicated by stable nitrogen isotope values), and habitat preference to shed light on the relative importance of factors that put snakes at risk of exposure to contaminants. Additionally, our results increase our understanding of the roles that snakes play in Hg transfer within food webs and will help guide restoration and remediation efforts currently underway.

Compost application practices improve quality of turfgrass and a degraded urban soil

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Removal of topsoil during suburban land development degrades soil properties and creates an environment unfavorable for vegetation establishment. A three-year field study was conducted to compare the effects of various compost rates and application practices on the attributes of a degraded urban soil and turfgrass establishment, growth, and quality. Treatments included: (1) synthetic fertilizer only, (2) 2.5 cm depth surface-applied compost, (3) 2.5 cm depth incorporated compost, (4) 5.0 cm depth incorporated compost, (5) 0.6 cm compost blanket, and (6) synthetic fertilizer plus straw mat covering. The compost was produced by windrow turning of a feedstock mixture of paper mill sludge, ground woody waste, and wood ash. Three years after initial one time treatment applications, turfgrass color and density were highest in the soils amended with 2.5 or 5.0 cm compost and the fertilizer applied according to soil testing recommendations. Highest turfgrass biomass yields during the final season of sampling were elicited by the 2.5 and 5.0 cm depths of compost incorporated into the soil. There were no treatment differences in turfgrass response to environmental stress as measured by photochemical efficiency. The 2.5 and 5.0 cm compost rates increased plant-available soil P, K, and Ca and decreased soil bulk density. Compost applied at a depth of at least 2.5 cm is a valuable amendment for renovating disturbed urban soils.

Soil moisture, nutrients, and microbial communities in the Monteverde Reserve forests: potential for monitoring of climate change

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Many of the tropical montane cloud forests, including in Monteverde, Costa Rica, are threatened by climate changes. Previous studies in the Monteverde Reserve (MR) suggested increases in the altitude, and reduction of the area, of the cloud layer over these forests may be associated with the decrease in moisture being observed. This recognition, and the well-documented flora and fauna declines, stimulated the Centro Científico Tropical to establish plots within 6 different habitats in the MR for use in establishing baseline characteristics of the ecological conditions, and diversity of the flora and fauna in the Reserve, and to monitor these for change over time. The first study conducted in these plots was to identify metrics for use in monitoring soil ecosystem health in the MR. The resulting data showed that habitats with more soil moisture, on both Pacific and Caribbean slopes, had greater amounts of fungal abundance, more fungal-dominated soils, and unique fungal and bacterial populations, more active N- fixation and incorporation of mineral N into the biomass, greater amounts of soil C biomass, and appeared to better select for N-fixing bacteria, basidiomycete fungi, and lignin degradation. The less moist soils had greater pools of mineral N and were more bacterial-dominant. This study demonstrated that biologically meaningful differences existed in soil nutrients, microbial populations, and soil biomass in different MR habitats, which were correlated with soil moisture, and that these metrics can be used to both elucidate ecological relationships and monitor soils for effects of future climatic or other anthropogenic disturbances.

Determination of a genetic basis for skewed sex ratios of Allegheny crayfish in Maryland

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A native species of crayfish, *Orconectes obscurus*, which lives in the Monocacy River of Maryland, has shown a very skewed sex ratio, with considerably more females than males. In crayfish, normal males have ZZ sex chromosomes while females have ZW. One hypothesis for skewed sex ratios seen in another crayfish genus is abnormal chromosomes where intersex males are hypothesized to be ZW. If reproducing males have these abnormal chromosomes, this would lead to populations skewed toward females. Another hypothesis for skewed sex ratios is parthenogenesis, where females reproduce without a mate. This would lead to offspring that are genetically identical to the parent. Parthenogenesis has been observed in members of a genus closely related to *Orconectes* suggesting that this process could also occur in *O. obscurus*. Parthenogenetic reproduction results in only female offspring, which could also explain the female-skewed sex ratio. The first goal of my research project is to develop a genetic marker that will be used to specifically identify the two different sex chromosomes, Z and W, in members of the genus *Obscurus*. The second goal of my research project is to use microsatellite DNA markers to assign a multilocus genotype to 40 confirmed females in order to determine if genetically identical individuals exist. These results will be used to determine if the cause of the skewed sex ratio in some populations of *O. obscurus* in the Monocacy River is due to chromosomal abnormalities or if the evidence is suggesting parthenogenesis as the reason for the skewed sex ratios.

Assessing the genotoxicity of Triclosan to American Bullfrog tadpoles

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Amphibians are particularly sensitive to environmental degradation and, therefore, serve as environmental quality indicators. Research has suggested that amphibian declines are exacerbated by manmade environmental toxicants, especially those found in high concentrations in urban areas. The NIH has pinpointed genotoxicity as a major route of cancer causation, and has since developed stringent testing procedures for potentially hazardous chemicals. One such method recognized for its simplicity and economy is the micronucleus assay. A study was conducted assessing the genotoxicity of the widely used antimicrobial agent Triclosan to American Bullfrog tadpoles. *Rana catesbeiana* tadpoles were reared in glass aquaria containing ultra-high purity water and were doused with nominal concentrations of 0, 0.0023 mg/L, 0.023 mg/L, and 0.230 mg/L Triclosan, reflecting 1x, 10x, and 100x concentrations of the compound as found in US surface waters. Eight replicates of each of the three levels of Triclosan contamination were prepared, as well as eight replicates per control group. Each replicate contained three tadpoles, from which one tadpole per replicate was destroyed after 1, 8, or 15 days following initial exposure. Erythrocytes were prepared and scored for micronucleus presence. Triclosan induced significant micronucleus formation after only 24 hours in 10x and 100x treatments, and in the 1x group after 15 days relative to the negative control. All treatments showed maximum induction at the 8 day endpoint. It is clear that the effects of genotoxic agents must be certified so proper regulatory protocols can be developed and enforced, in order to conserve wildlife and promote human health.

Plant community structure and ecosystem processes in response to disturbance gradients at Fort Pickett, Virginia

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Many disturbance studies focus on the impact of single events and do not address ecosystem responses to repeated long-term disturbance. Fort Pickett has experienced military training for over 60 years, providing a unique opportunity to assess long-term effects of two specific types of disturbance on plant functional group community structure, and ecosystem processes. Individual species were assigned to the following functional groups: C_4 grasses, C_3 grasses, forbs, woody species, and legumes. Vehicle disturbance was defined as the frequency of military vehicle passes at each plot. Fire frequency was calculated using historical data. Plant community data were analyzed using CCA and multiple linear regression. The first canonical axis explained 91.9 percent of the relationship between functional group cover and disturbance. There were significant relationships ($P < 0.05$) between functional group cover, richness and both measures of disturbance. Overall species richness increased in response to disturbance with C_4 grasses and legumes showing the greatest response. A removal experiment, using a split plot design, was used to investigate the relationship between disturbance, plant functional group and ecosystem processes. The whole plot treatment was disturbance class (Low, Moderate, High and Fire) and the within plot treatments were a full factorial removal experiment using C_4, legumes, and woody species. Response measurements were soil CO_2 flux, and mineralizable nitrogen. Soil CO_2 flux was significantly ($P < 0.05$) lower in the high physical disturbance class and highest in the fire class. Mineralizable nitrogen was significantly lower in the fire disturbance class.

Geographic variation in testosterone levels in the Rufous Collared Sparrow

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Tropical birds generally have lower testosterone levels than temperate species. Among tropical species, elevation is positively related to testosterone levels. While we do not understand why these relationships exist, they have been described in multiple across-species analyses. In the tropics, environmental conditions that can change notably with elevation include temperature and associated breeding season length. Further, parasitism risk is typically thought to be lower at higher elevations. We predict that within a species that is distributed along an altitudinal gradient, we should see local adaptations to elevation. Our objective was to determine if a positive relation exists between testosterone levels and elevation in a species distributed along and elevational gradient. The rufous collared sparrow, *Zonotrichia capensis*, has a wide elevational range and populations have breeding seasons that are negatively related to elevation, presumably due to an increase in high elevation seasonality. We measured testosterone levels in breeding season males along an elevational transect (600m, 1500m, 2100m, 3300m) in the Ecuadorian Andes. There were no differences in testosterone levels between the populations at the different elevations, suggesting that testosterone levels are not a trait that varies with elevation. However there was high intra-population variability, with individual birds having testosterone levels an order of magnitude higher than their conspecifics in the same breeding stage. Future studies will attempt to explain this inter-individual variation in plasma testosterone levels.

Human-augmented food resources in modified environments may lead to changes in behavior and disease in banded mongooses

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Humans can alter an environment by changing the food resources available to wildlife within human-modified landscapes. This change in food resources can have direct and indirect effects on wildlife behavior and infectious disease. In Northeastern Botswana, banded mongooses move regularly between natural and human-altered environments. 10-20% of the banded mongoose population are infected with the tuberculosis pathogen *Mycobacteria mungi* each year. We measured the number of aggressive sounds emitted per minute while mongooses foraged at five types of sites: 1) at garbage sites, which can contain discarded human food, 2) insect-attracting lights, 3) invertebrate-rich lawns, 4) other human-altered habitat without predictable human associated sources of food and 5) natural habitat. Aggression was higher in environments where human-augmented food resources were consistently available (Welch's ANOVA, $F=25.24$, $p<0.0001$; Kruskal-Wallis test). The largest differences in aggressive vocalization were identified between garbage sites and natural habitat (5.68 and 0.17 average aggressive sounds per minute, respectively; $Z=-13.71$, $p<0.0001$). Additionally, we found that incidences of injury and TB infection increased as the overall level of aggression within a troop increased ($R^2=0.88$). Troop size was poorly associated with the frequency of within troop aggression ($R^2=0.14$) or TB/injury ($R^2=0.18$). Thus, our data suggest that human-augmented food resources can cause behavioral changes in mongooses leading to an increase in TB disease and/or injury incidence. Environments with human-augmented food resources, a global phenomenon, may lead to important changes in wildlife behavior and health.

CARBON AWARENESS PARTNERSHIP (*CAP*)

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Both the 1st and 2nd author contributed equally to this presentation, Eric Hall will present

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Carbon emissions and transformations are of growing concern worldwide as levels of carbon dioxide, methane, and dissolved organic carbon (DOC) increase in our atmosphere and aquatic habitats. Understanding the carbon cycle and its regulatory processes is imperative in preparing the next generation to deal with the future effects of carbon fluctuations. The primary goal of our CAP program is to provide Virginia high school teachers with robust lesson plans and hands-on field and laboratory activities that focus on carbon processing and changing carbon dynamics in our world. Our secondary goal is to team VA teachers with VCU researchers in developing and delivering relevant research experiences to their students that follow the scientific method, satisfy multiple VA Standards Of Learning requirements, and expand scientific literacy and competency in students. In 2011, 60 high school students developed hypotheses and collected DOC, pCO2, chlorophyll *a*, and dissolved oxygen measurements from an experimental mesocosm array at VCU's Rice Center. During classroom visits this spring they will analyze their results and apply their conclusions to carbon cycling dynamics at local, regional, and global scales. In addition to ongoing school collaborations, we will conduct a summer teacher workshop that will provide 20 additional teachers with the CAP curricula and carbon research project. Our *CAP* program provides high school students and teachers a unique opportunity to interact with undergraduate and graduate researchers in hands-on field and laboratory experiments with practical applications to contemporary ecological issues.

Effects of vermicompost in potting soils and extract foliar sprays on vegetable health and productivity

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Vermicompost promotes beneficial organisms, nutrient life, and seedling growth in potting soils and suppresses plant disease through liquid extracts. We determined the utility of food waste-based vermicompost and thermophilic compost (on-site mixes produced at Dickinson College Farm, Boiling Springs, PA) in potting soils and extracts by comparing plant productivity and mineral composition to McEnroe commercial mix. On-site mixes contained equal volumes of peat moss, vermiculite and vermicompost or thermophilic compost. Two sets of 48 romaine lettuce (*Lactuca sativa var. romana*) and one set of 48 pak choi (*Brassica rapa subsp. chinensis*) seeds were planted with vermicompost-amended mix and extract (VC), thermophilic compost-amended mix and extract (TC), or commercial mix and water (C). The first lettuce set demonstrated significant differences among groups (ANOVA, $p<0.05$); average growth rates were 0.18 (VC), 0.12 (TC), and 0.21 (C) leaves per day (lpd). In the second lettuce set, overall differences among groups ($p<0.05$) indicated that C seedlings grew fastest (0.20, 0.17, 0.27 lpd, respectively). Germination rates and root:shoot weight ratios were similar among groups. Exploratory analyses showed that VC plants had the highest Brix, nitrate, and potassium levels, but the C mix had the highest nitrogen and potassium levels among mixes. These results suggest that vermicompost-amended mix could replace the commercial mix without reducing productivity if mineral amendments are added. Ongoing experiments will assess these amendments and coir (a coconut production byproduct) as a peat substitute. Since peat extraction causes habitat degradation and harmful emissions, this approach may identify more efficient, economical, and sustainable mixes.

Herbivory by white-tailed deer on invasive plants in suburban/exurban forests

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Pressure from overabundant white-tailed deer populations and an increased presence of non-native, invasive species have led to depauperate understories in suburban/exurban forests. As non-native species become more abundant in such forests, they themselves may become important targets of herbivory by deer. This study focused on potential deer herbivory on the invasive plants garlic mustard (*Alliaria petiolata*, ALPE) and Japanese stilt-grass (*Microstegium vimineum*, MIVI), and how overall deer pressure may influence abundance of and herbivory on these species. In 12 forests in central New Jersey, we measured vertical shrub cover as an index of chronic deer pressure. We then scored MIVI and ALPE abundance and browse herbivory during 10-minute visual scans along 9 deer or human paths in each forest. Of the 64 paths with ALPE, 17% showed browse on ALPE, and 23% of the 97 paths with MIVI showed browse on MIVI. Chronic deer pressure was positively correlated with both MIVI abundance ($P=0.05$, $n=12$) and the mean number of browsed MIVI plants observed per scan ($P=0.06$), but was not correlated to ALPE abundance or browse. It is clear that deer do browse on these two invasive species (and even possibly contribute to their dispersal). This suggests that, in highly invaded and deer-impacted forests, deer's previous role as a facilitator of invasion may be altered. When two co-invasive species like ALPE and MIVI differ in how they are impacted by deer, as our data show, then deer may become an important factor in their relative abundance and the resulting community structure.

Physiological differences between urban and rural song sparrow (*Melospiza melodia)* populations are apparent in some years, but not others

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Urban areas are expanding as the human population grows. Understanding how wildlife copes with habitat changes brought about by urbanization is therefore becoming increasingly important. Here we compare the hormonal stress responses of free-living urban and rural populations of song sparrows (*Melospiza melodia)* in southwestern Virginia across breeding seasons in two consecutive years. Our comparison focuses on baseline and stress-induced levels of corticosterone, an energy-mediating hormone. Corticosterone is secreted in response to a stressor, changing behaviors and suppressing non-essential physiological processes such as reproduction. While short-term elevation of corticosterone is thought to be adaptive, high baseline measures may indicate chronic elevation, which can decrease fitness. We found that corticosterone levels were higher in urban populations during the first year of study. However, in the second year, rural populations' corticosterone levels increased, such that urban and rural populations no longer differed. Similarly, bird body weight was lower in urban populations than rural ones during the first year, but this difference was absent during the second year. These data show that urban populations do differ from their rural counterparts under certain conditions, but that year-to-year shifts may mask these differences. Our findings suggest that urban populations may be buffered from inter-annual environmental shifts, while rural populations are not.

Support for urban ecology initiatives in the city of Chester, Pennsylvania using global positioning and geographic information system technology to spatially analyze shade trees

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The Chester Shade Tree Commission is an organization within the Chester Housing Authority that strives to educate the residents of Chester, PA about the benefits of trees. The volunteers of this commission remove deteriorated trees that are a potential safety hazard to the community, and then meetings are held about replacing these trees, planting trees in new locations, and maintaining existing trees in Chester. This effort can be supported with the use of Geographic Information Systems technology (GIS) integrated with Global Positioning System (GPS) surveying. The Sun Hill District, Chester Park, and the Route 291 Industrial Highway were selected for study and provided data on approximately 500 hundred existing tree locations. Potential planting locations were also mapped to help target urban reforestation activities. During the mapping, temperature sensors were used to collect data within and outside the shade footprint of several tree species along the Industrial Highway. This data showed a significant cooling effect provided by shade trees and can be used to support future funding initiatives and as an educational tool for Chester residents in the hope that the residents will take a more active role in improving their immediate environment. The results and procedures can be used as a conceptual model for future shade tree mapping projects within Chester and any other city.

Findings applicable to wetland restoration from a three-year study of natural patterns of plant colonization along excavated basin shorelines in relation to reproductive and life history traits

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Wetland restoration and creation projects often fail to function like natural reference wetlands. Colonization from local populations would be preferable, genetically, but is often constrained by lack of seed sources and/or by plants' life history traits. This three-year study took place in south-central Connecticut in the towns of Southington and Berlin on the perimeters of two excavated basins. Both were adjacent to natural seed source wetlands. Ten groups of 50 cm-wide, 1.5-3 meter-long transects were established perpendicular to the shorelines. Colonizing plants were recorded at the end of the growing season in ten centimeter squares, allowing age-class determination for most individuals; beginning of season data and heights were recorded in a subset of transects. Seed source communities were characterized. Supplemental data included weekly water levels, NOAA wind data (speeds and directions), seed buoyancy, and micro-topography of transects. The most successful colonizers were species with large, buoyant seeds that reach reproductive maturity early (e.g *Carex stipata, Polygonum punctatum, Echinochloa crusgalli,* and *Bidens frondosa spp.*) The seed source *must* be hydrologically connected to the basin. Populations expanded rapidly (30 fold for *Bidens frondosa* in one transect group). Seedlings survived ongoing sediment deposition on a delta. Some emergents (*Juncus effusus* and *Ludwigia palustris*) needed mid-summer drawdowns for germination in lower zones, but not others (*Alisma plantago-aquatica*). Seeding seems advisable for slow- maturing species like *Solidago rugosum* and *Eupatoreum perfoliatum,* also largely water dispersed, but often into unsuitable lower hydrologic zones; they were sparse in upper zones and upwind of seed sources.

Predation on nuts of the American beech (*Fagus grandifolia*)

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Beechnuts are an important food for various bird and mammal species, some of which serve as nut dispersers as well. Insects oviposit in beechnuts and their larvae also feed on the embryonic tissue. Thus, predators and dispersers both affect the reproductive potential of beech trees. I assessed arboreal predation on beech mast by examining fallen nuts and nut debris that were collected weekly during the 2011 masting season in standing baskets placed in the canopy shadow of selected trees. Rain of beechnuts and nut debris fell primarily between mid-August and mid-November with significant peaks in early September and late October. September debris consisted primarily of nut fragments discarded by foraging tree squirrels and birds (77%). Undamaged whole nuts accounted for only 15% of the September debris mass. Significantly, these nuts were either immature (5%) or barren (10%) and presumably offered a minimal energy reward to predators and had little potential for further development. In October, when trees naturally shed nuts (previously damaged and undamaged), debris consisted of 37% undamaged mature nuts, 20% undamaged barren nuts, and 41% insect damaged nuts (the majority likely due to natural shedding of nuts infested earlier, not to increased insect predation). Vertebrate predation accounted for only 2% of total debris in October when mature nuts were abundant. Preliminary analyses indicate that 60% of the seasonal debris mass resulted from the action of predators (≈21% by insects). Of nuts escaping depredation, 46% were barren (18% of total mass) and 54% were fully developed (21%).

Influence of resource gradients on soil microbial communities in a polar desert

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Microbial communities are major contributors to globally-significant ecosystem processes, yet our understanding of controls over bacterial community assembly and structure remains limited. To this end, here we apply macroecological models developed to describe productivity-diversity relationships in plant communities to soil bacterial communities of the McMurdo Dry Valleys, Antarctica. This is a model ecosystem for exploring relationships between biogeochemical (e.g. soil organic matter content) and biological (e.g. microbial community structure) parameters because of strong gradients in soil properties and trophically simple communities. Soils of the McMurdo Dry Valleys were sampled in the austral summer of 2010 along a natural productivity gradient and transported to Virginia Tech for analysis of a variety of properties including moisture content, soil organic matter concentration, and extra-cellular enzyme activity. We assessed soil productivity using an index based upon extractable chlorophyll *a* content normalized by organic matter content. A terminal restriction fragment length polymorphism (T-RFLP) technique was used to assess community structure and diversity based on the 16S rRNA gene. Results indicate significant variation in soil organic carbon, moisture content, total nitrogen, enzyme activity, and microbial biomass along the productivity gradient (ANOVA p-value ≤ 0.05). PCA ordination of environmental data indicates separation of samples based strongly on these same soil properties (correlation with PC1 and PC2 axes; $r > |0.6|$), while ordination of bacterial community TRFLP data suggests the separation of samples based primarily on soil physical characteristics, among them pH, which has been shown to be a major driver of soil bacterial diversity worldwide.

Changes in methane fluxes of tidal wetlands along a naturally occurring salinity gradient in the James River

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One potential impact of global climate change is sea level rise and modifications of the hydrologic cycle, which may cause saltwater intrusion into tidal freshwater wetlands. Soil microbial communities in wetlands mediate several of earth's global biogeochemical cycles, including the carbon cycle. Methane (CH_4), a greenhouse gas and important component of the carbon cycle, has twenty times the global-warming potential of carbon dioxide (CO_2). Carbon can be oxidized to produce CH_4 (methanogenesis) in anaerobic soils by microorganisms; however, the addition of sulfate from seawater can change redox chemistries and alter this process. Aerobic methane-oxidizing microorganisms that rely on methanogenesis for energy may also be adversely affected. This work seeks to determine how methane production and oxidation may change as a result of saltwater intrusion into tidal wetlands. Eight soil cores with vegetation were collected from four wetlands along a naturally occurring salinity gradient in the James River. Net methane production was measured over time for each core using airtight chambers. A methane oxidation inhibitor, difluoromethane, was added to half of the chambers to quantify gross methane production. Results indicate significant differences in net and gross methane emissions ($p < 0.001$ for both) between sites, suggesting microbial activity in these wetlands differs. Higher production appears to correspond to lower salinity. Methane production pre- and post-inhibitor (gross > net, $p=0.002$) suggests there is a significant contribution by methane-oxidizing organisms in these systems. By coupling this information with abundance of corresponding functional groups (qPCR), we can create an interdisciplinary study that combines biogeochemistry and microbial ecology to examine the potential effects of saltwater intrusion into tidal freshwater wetlands.

Pedagogy for the rest: Improving ecological literacy through a student-centered problem-based non-majors environmental science course

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Inspired by Tompkins (1990), Friere (1970), Dewey (1933), and others, I have designed a model for a student-centered non-majors environmental science course. Critical pedagogy (Giroux 1989) enjoins that our students must critically reflect upon why they are learning what they are learning – our science courses must teach not only ABOUT science, but also what scientific knowledge is FOR. Yet, critics protest that this supplants teaching "how to think" with a "what to think" agenda. My model rejects this pseudo-dichotomy in that the essential dimensions of "relevance", "scientific causality", and "stakeholder mapping" are articulated and presented by students to their peers – within an instructor-constrained epistemologically and pedagogically sound paradigm. My model teaches students how to think AND how they can use scientific knowledge to solve sustainability challenges. We first articulate five major environmental issues/challenges currently of importance to THEM (e.g., climate change, mountaintop removal, oil spills, beach erosion, fracking, environmental injustice). Next, students form groups to research, organize, and run 6-8 classes, during which they present ecological/environmental/policy attributes of their issue and explore solutions. I meet with the leader group to discuss their content and peer engagement methods, I intervene during class to calibrate scientific information and argument validity, and with leader group input, I write and grade exams. Evidence indicates that my students, all of whom comprise the "99%", increase their understanding of the complexities, necessity, and processes of environmental problem solving. This course renews my hope that teaching matters in the sustainability education of the next generation.

Defining critical forest habitat for area-sensitive songbirds in Pennsylvania

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Forest fragmentation in the state of Pennsylvania is increasing due to expanding energy infrastructure, notably gas drilling in the Marcellus Shale formation. Forests are cleared for roadways, drilling pads, and waste storage, which results in a loss of un-fragmented interior forest habitat. Many forest-obligate birds are known to be sensitive to edge effects and loss of interior habitat, which can cause reductions in nesting success and abundance. We used data from more than 33,000 point counts (conducted in 2004-2009) to determine which among a suite of 40 bird species showed settlement patterns that were consistent with area sensitivity, i.e., an avoidance of edge/fragmented forests. We found that 19 of the 40 species were area-sensitive (Kolmogorov–Smirnov test, $P<0.05$). We produced spatially explicit indices of area-sensitive songbird abundance and species richness, which allowed us to highlight areas that are critically important for these species. The Allegheny National Forest and large contiguous areas of several state forests were found to be particularly important. We recommend that energy infrastructure development in these areas is minimized or deferred, to avoid substantial loss of habitat for area-sensitive songbirds.

Human disturbance, incubation rates, and nest survival of colonial waterbirds at Cape Lookout National Seashore, North Carolina

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There is no consensus concerning the effects of human disturbance on avian nest attendance and survival. Our study measured impacts of aircraft and off-road and all-terrain vehicles on incubation rates and nest survival of Least Terns (*Sternula hirundo)*, Common Terns (*Sterna hirundo*), Gull-billed Terns (*Gelochelidon nilotica*), and Black Skimmers (*Rynchops niger*) at Cape Lookout National Seashore (CALO), NC. We deployed time-lapse covert infrared cameras at a random sample of nests at 6 colonies from May-August 2010 and 2011 to document the type and frequency of these disturbance events and their effects on nesting attendance and survival. We randomly sampled nest attendance for a 5-min sample before, a variable length sample during, and a 5-min sample after disturbance events from a pool of 186 Least Tern, 9 Common Tern, 3 Gull-billed Tern, and 24 Black Skimmer nests to determine whether nest survival was influenced by nest attendance, and if nest attendance is influenced by human disturbance. We also evaluated whether incubation rates varied by species, time of day and season, and/or the occurrence of human disturbance. Preliminary analyses suggest nest attendance varies little by time of day and season for all but Black Skimmers, which tended to be absent from nests more at night. Nest survival was independent of both incubation rate and human disturbance for all species. This suggests either that human disturbance has no effect on these behaviors, or that the current 150ft buffers around colonies are sufficient to protect the nesting waterbirds from deleterious effects of human disturbance.

Helping students understand global warming and carbon cycles using research projects on woody debris, aboveground biomass, and litter decomposition

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Understanding of global warming and its consequences are still inadequate among the general public despite the urgency and potential dangers. It is imperative that we develop effective and powerful strategies for educating students about global warming to help reverse this trend. Lab activities and research projects can be a very effective means for helping students understand the carbon cycle and its relationship to global warming. Aboveground biomass, woody debris measurements and litter bag decomposition studies are relatively simple and cheap methods of introducing students to carbon cycling research and how it relates to carbon dioxide in the atmosphere. Measurements of aboveground woody biomass in younger and older forests allow students to determine in one or two lab periods how forests can be used to store carbon. Woody debris inventories are simple and straightforward and can be interesting research projects for students. Recently conducted woody debris inventories of two old-growth forests by four students helped them to appreciate the value of old-growth forests for storing carbon. Their data is of high quality and could eventually be used in a publication involving several more forests. Litter bag decomposition studies are also simple, low cost approaches to exposing students to carbon cycling, although they can require up to a year to conduct. These types of research activities have been a powerful means for helping students understand the carbon cycle and involving them in the broader issue of global warming. These studies are inexpensive, require little equipment, and often produce new and useful data for the broader scientific community.

Microbial diversity: A spatial study of microbial community assemblages in the Floridian Aquifer

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Microbial diversity is one fraction of ecosystem diversity that demands greater attention due to the sensitivity of microbes to their environment. Past studies have elucidated the importance of microbial assemblages, but few studies have looked at regional scales to evaluate how environmental conditions could affect the community assembly. This study examines the Floridian Aquifer to evaluate conditions (light, redox potential, anions, dissolved oxygen (DO), pH, alkalinity) that may play significant roles in affecting microbial communities. Thirteen sites were chosen, 3 in North Florida and 10 in Central Florida, to compare environments to molecular fingerprints using 16S phylogeny and Terminal Restriction Fragment Length Polymorphism (T-RFLP) techniques. Using multivariate analyses, patterns emerge demonstrating conditions, such as redox and light, have significant affects on the microbial communities (ANOSIM, $p = 0.001$). Further non-parametric analyses reveal that sites in northern Florida are significantly different from Southern Florida sites (ANOSIM, p-value < 0.01). Also, multivariate analyses NMDS (Non-Parametric Multidimensional Scaling) and CCA (Canonical Correspondence Analysis) demonstrate underlying interactions that may be the cause for differences seen at sites. Hence, in order to understand how microbes naturally interact with their environment, measures must be taken to evaluate each site as a separate entity. Increased knowledge about these sites enhances the ability to predict whether an area has contamination by the assemblies found in the ecosystem. By evaluation of microbial communities as a response to changes in environmental factors, we can increase the predictive powers policy makers have in decisions involving the ecosystems.

Maternal mercury exposure has negative consequences for turtle reproduction

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In addition to the suite of beneficial resources that females allocate to their offspring, research has demonstrated the maternal transfer of a wide variety of harmful contaminants. For example, the maternal transfer of mercury (Hg), a common and highly toxic environmental contaminant, has been shown to negatively influence several reproductive parameters in birds, fish and amphibians. Additionally, Hg can bioaccumulate and biomagnify within food webs, exposing long-lived apex predators to high levels of Hg. Based on these observations, we evaluated the consequences maternally transferred Hg on a long-lived aquatic omnivore. We collected eggs and tissues from gravid female snapping turtles (*Chelydra serpentina*) along an Hg contamination gradient of a historically contaminated river and nearby reference sites located in central Virginia. We incubated eggs in the laboratory, quantified embryonic morality, infertility, and hatching success of each clutch, and assessed all hatchlings and dead embryos for gross morphological malformations. We found that egg Hg negatively influenced hatching success through increased egg infertility and embryonic mortality. However, we found no effects of egg Hg on malformation frequency, clutch size, or egg mass. This is the first study to demonstrate direct effects of maternally transferred Hg on hatchling survival in turtles and our results suggest that Hg may also affect other female physiological factors important for reproduction. Ultimately, the lethal effects of Hg on offspring could affect turtle population viability and may serve as a source for phenotypic variation within turtle populations inhabiting Hg contaminated areas.

The roles of fire and environmental factors in plant community dynamics of high-elevation yellow pine woodlands in northeastern West Virginia

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An understanding of the historic role of fire in high elevation (> 650 m) pine woodlands of the central Appalachian Mountains should inform management of these fire-adapted habitats, but information of this sort is currently limited. I tested the hypothesis that fire perpetuated yellow pine (*Pinus rigida* & *P. pungens*) woodlands on ridges and associated slopes in northeastern West Virginia and that stressful habitats such as cliffs and bogs provide safe sites for pine recruitment and do not require fire for persistence. I recorded plant abundance, tree size structure, pine recruitment, and evidence of fire at 46 sites in the Ridge and Valley and Allegheny Front of northeastern WV. Cross-dated increment cores and fire scar samples were used to determine fire dates, frequency, and seasonality. Ten plant community types were described using cluster analysis and NMS ordination of abundance data. An index of fire evidence (FEI; 0-4 kinds of fire evidence present per site) varied significantly across community types and species composition as represented by NMS axes. A complex picture of the role of fire emerged that did not confine it to any particular community type or landform; however cliffs and backslopes had significantly more evidence of fire. Pine seedling regeneration was strongly determined by landform, with 94% of all seedlings (< 1 m tall) found on cliffs or bogs. Fire history and landform type likely work together to influence plant community composition, and these factors were combined into a conceptual model of high elevation pine successional dynamics.

Elemental defense in *Alyssum murale*: impacts on specialist and generalist insect herbivores

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The "elemental defense hypothesis" formulated by Boyd & Martens (1998) suggests that metal hyperaccumulating plants deter herbivory by maintaining high levels of toxic metals in their tissues. This study explores the effectiveness of elemental defenses in *Alyssum murale* Waldst. and Kit. (Brassicacae), a Ni-hyperaccumulator from the Mediterranean region that sequesters 2-3% Ni in its shoots. We are examining two kinds of introduced specialist herbivores that feed on plants in the Brassicaceae: harlequin beetles (*Murgantria histronica*), and cabbage butterfly larvae (*Pieris rapae*).We are also examining larvae of the painted lady butterfly (*Vanessa carduii*), a cosmopolitan generalist herbivore. *Murgantria* adults were field collected from cabbage plants in Clarke County VA, and caged with individual *Alyssum murale* plants grown at three soil nickel concentrations: 100 ppm, 500 ppm and 2000 ppm. After six weeks, loss of plant tissue to herbivory was compared to initial biomass. We found a trend relating the strength of herbivory to the nickel concentration in the soil. Biomass consumption at higher nickel levels (500 ppm and 2000 ppm) was 35-40% lower than biomass consumption at the lowest nickel level (100 ppm). We believe this is the first study to show that *Murgantria histronica* consumes a Ni-hyperaccumulator such as *Alyssum murale*. Insect herbivory on *A. murale* leaves is a potential avenue to move Ni further along the food chain, amplifying its potential toxic effects. Additional data will be reported from further studies that are currently underway to examine the interaction of *Alyssum murale* with *Pieris rapae* and *Vanessa carduii*.

Stewardship success: How community group dynamics affect urban street tree survival

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Over the last two decades, there has been a massive upswing in street tree plantings across the country. Many cities have set ambitious planting goals, relying in part on volunteer community groups to meet them. Existing research demonstrates that community stewardship substantially increases the survival of urban street trees. Studies also show that contractors experience a range in survival rates post-planting, depending on their planting and handling methods. There is a lack of research, however, on how variables across community groups affect the survival of the street trees they plant. This study examines survival of urban street trees, as a factor of community group size (# participants), type (apartment, block watch, church, neighborhood residents, park, public housing, school, and social service), planting longevity (number of years planting), experience level (number of trees planted), and neighborhood (geo-political boundaries). 1388 trees were sampled, planted from 1995 to 2007, by 153 groups through the Urban Resources Initiative's Greenspace program in New Haven, CT. There was an overall survival rate of 76%. Preliminary results indicate lower survival of trees planted by community groups with high participation rates during the planting year. Trees planted by public housing groups had the lowest survival across group types. Highest survival was observed among trees planted as part of larger scale plantings. This research can offer guidance for management officials, indicating groups that may require particular assistance in conducting successful, lasting street tree plantings.

Response of the invasive Asiatic sand sedge to beach nourishment

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In the State of New Jersey, one plant species of concern is Asiatic sand sedge (*Carex kobomugi*), which is invading dune systems along the coast. This sedge was first introduced accidently and was then used extensively in dune stabilization programs during the decades of 1960 and 1970. Recent work has revealed that the sedge reduces native diversity and fails at accreting sand, which is problematic for dune formation and growth. A proposed treatment method for the species is beach nourishment (burial). We hypothesize that beach nourishment would actually promote growth of the invader rather than be a useful control method. Thus, the objective of the study is to evaluate the impacts of various burial depths on the sedge. Five burial depth treatments were replicated at three study sites at Island Beach State Park, NJ. Growth and physiological responses of the sedge and native species, American beach grass (*Ammophila breviligulata)* and seaside goldenrod (*Solidago sempervirens*), were monitored biweekly from May 2011 to the present. After one growing season, only the sedge emerged at each burial depth. Early physiological responses indicate that nourishment promotes the growth of the sedge while impeding the productivity of the native species. These results indicate that nourishment is not a viable control method.

Ontogeny of risk across the aquatic-terrestrial interface: how changing behavior and morphology affect predation through anuran metamorphosis

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Metamorphosis dramatically changes morphology, physiology, behavior and performance. As anurans change from aquatic tadpoles to terrestrial juveniles, they pass through a period of poor locomotor performance and high predation risk, and individuals behaviorally determine when they shift habitats. Red-eyed treefrogs, *Agalychnis callidryas*, alter when they move onto land in response to aquatic giant water bugs and semi-terrestrial fishing spiders. We conducted predation trials and behavioral experiments at multiple stages to assess changes in the interactions of *A. callidryas* with each predator through metamorphosis. In aquatic trials, *A. callidryas* reduced activity with both forelimb emergence and chemical cues from water bugs. Nonetheless, forelimb emergence substantially increased the predation rate. In semi-terrestrial trials, conducted in shallow water with dense floating vegetation, metamorph activity increased as tails were resorbed, and metamorphs did not reduce activity in the presence of a spider. Predation by spiders increased as metamorphs resorbed their tails. Close observation in small venues revealed that most spider attacks occurred after metamorph movements, and attack rates on shorter-tailed metamorphs were higher. Longer-tailed metamorphs were, however, less likely to escape from attacks. Thus, the ability of metamorphs to behaviorally compensate for morphological constraints on escape ability appears to be better out of the water. Nonetheless, in natural ponds, the effect of activity on the rate of encounters with pond-associated predators will depend on how rapidly metamorphs leave the environs of the pond.

UV^+/UV^- experiment on growing snapping turtles (*Chelydra serpentina*): implication for disturbed environments

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Exposure to UV radiation is essential for proper growth and health in many reptilian species, particularly aquatic turtles. We carried out a UV^+/UV^- experiment with juvenile common snapping turtles (*Chelydra serpentina*) to test the effects on growth rate. Two groups of 64 day old snapping turtles (7 each) were placed in separate UV^+/UV^- compartments of an enclosure under controlled temperature and photoperiod 12h:12h. The animals were fed twice daily and food was available ad libitum. The enclosure was fitted with ReptiSun 10.0 High Output UVB bulbs; the bulb on the UV^- compartment was fitted with a UV filter. Turtles were individually marked by clipping marginal scutes and were measured at regular weekly intervals. We measured mass, carapace length, carapace thickness, carapace width, and carapace width minus marginal scutes. The animals raised in UV^+ and UV^- conditions did not show any significant differences in their growth rate up to 175 days. We speculate that the common snapping turtle, a reptilian, which is exposed to the sun for much of its life history, is immune to UV radiation up to 0.042 mw/cm^2. In the scenario of UV increase due to depletion of ozone layer, growing snapping turtles will not be significantly impacted.

A comparison of soil respiration in turf grass and agricultural environments

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Soil respiration is the process by which carbon dioxide is released from soil organisms into the atmosphere. Land use type and environmental factors such as soil moisture and temperature have been found in many studies to influence levels of soil respiration. Few studies have, however, examined differences in soil respiration between contrasting human-dominated land uses. In this study, we tested the hypothesis that soil respiration, as measured by CO_2 flux, would differ between agricultural and turf grass environments in Lancaster County, PA. We had eight study sites, four were residential lawns and four were corn fields. Soil respiration, temperature, and moisture were measured at two locations in each study site using the LI-8100 Automated Soil CO_2 Flux System once a week for ten weeks in fall of 2011. The data were then analyzed using a repeated measures GLM. Soil respiration occurring in turf grass environments was significantly higher (F_1=7.46, p=0.034) than the levels in corn fields, with means of 2.05 μmol CO_2 m^{-2} s^{-1} and 1.23 μmol CO_2 m^{-2} s^{-1}, respectively. Rates of soil respiration significantly decreased over time in both land use types (F_9=37.34, p<0.001). Transitioning from agricultural land to developed areas such as housing developments could mean an increase in CO_2 production per unit area of converted agriculture. This has implications when considering land use change and the effect this has on the overall increase in worldwide emission of CO_2.

Rotten to the core: red-cockaded woodpeckers and wood-inhabiting fungi

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Federally endangered red-cockaded woodpeckers (*Picoides borealis*) are primary cavity excavators in the longleaf pine ecosystem, and are unique in that they solely excavate their cavities in the heartwood of live pine trees. This process takes years to complete, but certain types of heartwood infecting fungi can decrease excavation time. Incomplete excavations are termed cavity starts and are gaping wounds in the trunks of trees. Thus, cavity starts are possible infection sites for the heartwood infecting fungi that are suspected to facilitate cavity excavation. It is also possible that red-cockaded woodpeckers may carry fungi from their roost cavities into cavity starts. We studied the fungal communities in red-cockaded woodpecker initiated cavity starts and fully excavated red-cockaded woodpecker cavities. Additionally, to specifically test if red-cockaded woodpeckers facilitate heartwood infection of longleaf pine trees by the transmission of fungi in the early stages of cavity excavation, we employed woodpecker accessible and inaccessible man-made cavity starts. We will show how the infection rates in both red-cockaded woodpecker initiated and man-made cavity starts change through time. In addition to these data, we will present results from a DNA-based study that explores the communities of fungi within the excavations that comprise our experiment. Our results point to a much more complex story than that presented in current red-cockaded woodpecker literature

Response of microbial communities to matric and osmotic stress in soil systems

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Water dynamics (drying and rewetting) in terrestrial ecosystems are thought to be physiologically demanding to microbial communities and impact ecosystem energy and nutrient cycles. Most known mechanisms of microbial response to water dynamics are derived from studies in laboratory culture, where microbes are relatively unstressed compared to environmental conditions. This is particularly true with regard to available C and nutrients. An experiment was thus conducted to understand one mechanism of microbial adaptation and to test the osmolyte accumulation hypothesis (OAH) in soil systems. Two soils with different water regime histories, Marietta and Sumter, were exposed to a soil desiccation gradient (-0.03, -1.5, -4.5, -10, -20, -40 MPa) using both drying (matric) and salts (osmotic). Sugars and amino acids were measured to directly assess the OAH hypothesis. Structural changes in the community were monitored using PLFA. An increase in the sugar concentrations at moderate drying intensities in two soils was observed. However, while GC analysis showed the presence of various sugars and polyols (glucitol, mannitol) that can be used to cope with cellular water loss, concentrations of these molecules did not increase with desiccation. Differences in microbial community structure, especial fungal to bacterial ratio indicate that soils are somewhat unique in their response to desiccation. Neither soil communities showed responses to desiccation congruent with the OAH hypothesis. The reallocation of cellular membrane fatty acids, and cellular sugars may play a role in microbial adaptation to desiccation.

Real-time ecologic interactions and their effect on the bioaccumulation of DDE by the worm species *Eisenia fetida* and *Lumbricus terrestris*

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To determine the lasting ecologic consequences of persistent organic pollutants in soil, real-time synergistic interactions between worms and plants were examined. The bioaccumulation of p,p'DDE by two worm species (*Eisenia fetida* and *Lumbricus terrestris*) was measured, when these worms grew in p,p'DDE contaminated soil with, following and without the presence of the squash species *Cucurbita pepo*. A significantly greater difference of bioaccumulation was observed in the worm species *Eisenia fetida* when the worm was present in the soil at the same time as the squash. In the absence of squash, or following the presence of squash; bioaccumulation of p,p'DDE was significantly lower. There were no observed differences in bioaccumulation of p,p'DDE by the worm *Lumbricus terrestris* in the same treatments. At two different temperature settings, variable temperature and constant temperature in a growth chamber, the species *Eisenia fetida* showed no significant difference in bioaccumulation. In the species *Lumbricus terrestris*, a significantly greater amount of bioaccumulation was observed at a constant temperature compared with a variable laboratory temperature. A second run of this experiment is being performed currently to confirm these results. Lastly, bioaccumulation of p,p'DDE was measured in two different laboratory growing settings, a beaker and a cone. No significantly different levels of bioaccumulation were observed in either worm species, in either growing condition. These results show that real-time ecologic interactions matter significantly in trophic transfer and initial bioaccumulation of persistent organic pollutants. The consequences of these interactions have serious implications for future restorative ecologic practice and environmental management.

Microbial carbon processing in tidal freshwater wetland soils and the impending impacts from saltwater intrusion

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Tidal freshwater wetlands (TFWs) are intermediary systems bridging the gap between terrestrial and aquatic ecosystems and are important in the sequestration of soil organic carbon. With the ever changing global climate, TFWs are left vulnerable to downstream effects of rising sea level and saltwater intrusion due to increase in precipitation and flooding. These changes often act over large spatial scales, but the scale can vary over local and regional scales resulting in significant impacts. This multidisciplinary study assessed the amount and lability of desorbed organic carbon in tidal freshwater wetland soils from the Waccamaw River, South Carolina ("organic" soils, 50-65% organic content) and Pamunkey River, Virginia, ("mineral" soils, 13% organic content). Soils from each wetland were extracted at salinities 0-35 and the dissolved organic carbon (DOC) concentration and carbon lability of the leachates were measured. Based on the resulting parameters, the soil desorption shows an increase in the amount, rate and percentage of DOC in the organic soil in comparison to the mineral soil. These measurements also indicate as salinity increases, there is a positive correlation in respect to the amount, rate and percentage of DOC. Short-term bacterial production was compared to long-term DOC lability to determine differences in carbon quality. EEM fluorescence spectra of the DOC was used to characterize the organic carbon into autochthonous and allochthonous components. By understanding how saltwater intrusion affects desorption and lability of soil organic carbon, it can demonstrate how climate change will play on regional carbon storage and the global carbon cycle.

Host plants and agro-ecology of the invasive brown marmorated stink bug in Virginia

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The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), was accidently introduced into the United States from Asia probably in the mid-1990s. Since the pest was first identified in 2001 in Allentown, Pennsylvania, it has spread to numerous states as well as southern Ontario, Canada. Currently, significant pest populations of the bug remain centered around the mid-Atlantic U.S., but appear to be spreading fast. Much notoriety and media attention has been given to BMSB over the past year, particularly related to its role as a nuisance pest aggregating in man-made structures in the fall and as a devastating pest of tree fruit. However, there is much to be learned concerning the ecology of this polyphagous bug as it invades new territories. Herein, we report on our first-year of seasonal observations of the bug in natural/disturbed wooded environments and agroecosystems in southwest Virginia. Visual surveys throughout the 2011 growing season were conducted to determine preferred host plants and the seasonal biology. In the spring, the highest numbers of BMSB were recorded on the invasive tree of heaven, *Ailanthus altissima* (Mill.) Swingle, as well as several other wild host trees and the first appearance of BMSB eggs occurred in early May. By mid-summer, fewer bugs were found in wild trees, but densities increased on agricultural crops. A strongly-preferred vegetable host was sweet corn, *Zea mays* L. followed by beans, okra, peppers, and tomato. Additionally, graphing of life stages in conjunction with accumulated degree days suggested that BMSB had a single generation in southwestern Virginia in 2011.

Organic matter dynamics of reconstructed streams draining mines in the central Appalachians of Virginia

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Mining of coal is a large scale disturbance affecting both terrestrial and aquatic ecosystems in the central Appalachians. Compensatory stream mitigation projects are intended to produce ecological benefits to offset those lost due to mining impacts. Post-construction assessment of headwater stream reconstructions has historically focused on structural measures such as water chemistry, channel stability, habitat features, and biotic assemblage metrics. Recent guidance from USEPA requires assessment and replacement of functional attributes. Allochthonous organic matter serves as essential habitat and an energy source within headwater and downstream environments. Therefore, organic matter dynamics are essential to functional assessment of reconstructed stream condition. We investigated relationships of physicochemical factors with leaf litter breakdown rates of *Quercus alba* using both coarse and fine mesh litter bags. Rates (day^{-1} and $degree\text{-}day^{-1}$) were determined for eight low-order mining-impacted stream reconstructions and compared to four minimally impacted reference streams. Rates were calculated based on an exponential decay model using percent ash-free dry mass remaining (%AFDM-R) of triplicate retrievals for the deployment period (~9 December, 2010 ~ 15 October 2011). Structural variables were also measured for each stream, including specific conductance, discharge, and ionic concentrations; relationships of these variables to breakdown rates were analyzed. Cursory discussion of additional functional measures of organic matter dynamics we are studying will also be presented.

Dendrochronology and fire history of *Pinus rigida* on North Fork Mountain, West Virginia

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Pitch pine (*Pinus rigida*) is a fire-adapted tree found on central Appalachian ridges, including North Fork Mountain in the Monongahela National Forest, WV. Though pitch pine has dominated historically, in many areas of its range it is not reproducing as well as shade-tolerant hardwood species. Future loss of fire-adapted pine habitat poses risks for biodiversity. Community change may be the result of fire suppression and exclusion policies, which over time allow less fire-adapted species to develop. As little is known about historic fires at high elevations, my study aims to reconstruct fire history on North Fork Mountain using dendrochronology. Nine sites were chosen based on pine presence and evidence of past fire, including fire-scarred trees, burned coarse woody debris, and soil charcoal. Increment cores were taken in 2009 from living pitch pine trees to construct a master chronology using skeleton plots. This master chronology was later used to date fire-scarred samples collected from each site in 2010-11. We hypothesized that fire suppression and exclusion policies led to a reduction in the number of fires after 1930-40. Further, we predicted fires to have peaked in the late 1800s at the height of agriculture, before fire-suppression and exclusion regimes were implemented. Preliminary results indicate at least two fires that scarred more than one tree occurred on North Fork Mountain: one in 1931 and another in 1962. Information on fire history, frequency, and seasonality will inform management using prescribed burns in high elevation pine habitats in the central Appalachians.

Increase in aquatic resource impacts from longwall coal mining following revision of Pennsylvania underground mining law

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Coal mining has been practiced in Pennsylvania for more than 200 years. Historically, underground coal mining has been done primarily by the room-and-pillar method, whereby pillars of coal are left in place to support the mine roof and prevent surface subsidence. Longwall mining is a relatively new method of underground mining, having been introduced into the United States during the 1970s. It is a highly mechanized, efficient, and profitable method of underground coal extraction used in settings where a coal seam is of uniform thickness. Surface subsidence is an integral part of the longwall method, and it results in significant impacts to aquatic ecosystems. The principal Pennsylvania law associated with underground coal mining was enacted in 1966. It included a prohibition on damage to surface structures, but for nearly three decades its direct protection of structures provided *indirect* protection to streams, springs, and wetlands in the vicinity of protected structures. That prohibition impeded the widespread use of the newer longwall technology. In 1994, the 1966 law was amended by "Act 54" which specifically allowed damage to structures and other surface features, but required mine operators to mitigate certain damages. Follow-up reports mandated by Act 54 demonstrate that impacts have been occurring at a rate and intensity that were not anticipated when the law was amended 18 years ago. In particular, streams and wetlands damaged by longwall mining are seldom restored to their original condition.

Differential impacts of tree seedling diversity on resistance to big versus small enemies

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Global biodiversity is declining and nearly a decade of research has shown demonstrable links between biodiversity and ecosystem functioning, including increased productivity, resistance to disturbance, and stability. Over half the world's terrestrial diversity resides in forests, yet most biodiversity studies have been conducted in terrestrial grasslands, and large vertebrates are often explicitly excluded from biodiversity studies despite the common observation that they can have large impacts on plant biodiversity and ecosystem function. Here, we used a manipulative experiment to ask whether tree seedling diversity influences community function by conferring resistance to deer, herbivorous insects, and leaf pathogens. We factorially manipulated tree seedling diversity (one versus 15 species) and vertebrate herbivory (presence/absence of white-tailed deer) in >250 established 1m² plots and measured mortality and enemy damage over one growing season. Diversity had a significant positive effect on survival, increasing survival by an average of over one seedling per m². The diversity effect may have arisen because of associational resistance to deer, as species that were heavily browsed by deer in monocultures were significantly less browsed in mixtures. In contrast, insect damage did not differ in polycultures versus monocultures, indicating differential effects of diversity on vertebrate versus invertebrate herbivores. Fungal pathogens were more prevalent in mixtures, but only when deer were absent. Our findings indicate an important, if little understood, effect of plant diversity in modulating resistance to big versus small enemies.

Avian reproduction in response to vegetation restoration on reclaimed surface-mines in southwest Virginia

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Surface mine reclamation creates vast amounts of early successional habitat used by many avian species currently in decline throughout North America. Many studies of breeding bird response to surface mine reclamation have focused on grassland dwelling species because the more traditional approach to surface mine reclamation was to seed large areas with aggressive herbaceous ground covers to help prevent soil erosion. A diversity of reclamation practices are available for mine operators, depending on the specific goals of the landowners for the post-mined lands. The Forest Reclamation Approach (FRA) is a new, cost effective reclamation technique aimed at restoring viable hardwood forests on post-mined lands in the Appalachians. Little is known about the reproductive success of thamnic (shrub-scrub dwelling) species, and no studies have examined the impact of different vegetation restoration regimens on avian reproductive success on reclaimed surface-mined lands. We examined nest site selection and evaluated nest success of field sparrows (*Spizella pusilla),* and indigo buntings (*Passerina cyanea)* in response to different reclamation regimens. We also estimated seasonal fecundity to determine population stability on reclaimed surface-mines. Lastly, we give suggestions for land managers to provide better quality breeding habitat and implement in future reclamation efforts.

Urban habitat moderates seasonality in the stress physiology, movement ecology, and foraging behavior of free-ranging banded mongooses

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With increasing pressure on pristine wildlife habitat and growing impact of reconciliation ecology, many species are colonizing urban environments. While some work has been done on indirect effects of urban life on wildlife physiology and fitness, these effects, particularly on stress physiology have not been characterized for most species. We investigated the effect urban life, particularly dietary augmentation, has on stress physiology, movement ecology and foraging behavior of a social carnivore, the banded mongoose (*Mungos mungo*). We used non-invasive fecal glucocorticoid monitoring, giving up densities, and home range utilization to investigate the these effects on fourteen troops of free-ranging mongooses in habitats ranging from near-pristine to urban in a seasonal environment. Glucocorticoid concentrations from 1900 feces strongly supported a candidate mixed effects model with year, troop and a troop*season interaction as effects. Closely competing models included habitat type and a habitat*season interaction. Seasonality in glucocorticoid production, expected to vary with food availability was absent in urban troops while rural troops had elevated glucocorticoids in the food-limiting dry season. Home range utilization was focused on food augmentation sites for urban troops, but was diffuse for rural troops. Troops without access to anthropogenic food had larger home range sizes. Further effects were seen in foraging and vigilance behavior and in foraging-vigilance trade-offs. Chronic elevation of glucocorticoids has been implicated in immune suppression, which we discuss for this population. These indirect effects and implications for fitness in urban wildlife will increasingly be important considerations in conservation as we continue to expand urban environments.

Modeling genetic differences in tree growth responses to changed climate with provenance tests data and mixed-effects modeling techniques

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Modeling forest tree species response to changes in climate and identifying whether such response is species or population specific has become of crucial interest in the face of projected global change. Historic provenance tests are a readily-available source of data and new analyses of these data are yielding relevant insights about responses of species and their populations. However, differences between the objectives used to design the experiments and current objectives impose limitations to what can be learned. Our objectives are 1) to discuss important characteristics of provenance tests data that define what can be learned from their re-analysis from a biometrical point of view, and 2) to present a modeling approach that creates a speciesand population-specific model while taking into account data characteristics. We illustrate the modeling approach for two conifers. Results indicate that: 1) our modeling approach allows the identification of species- and population-specific responses, 2) changes in climate for these species will have disparate effects, but if changes are large enough in either direction, the impact will be negative.

Can plant trait responses and their effects on ecosystems be generalized across land use intensity gradients and biomes

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To reveal universal environment-trait-ecosystem relationships, we compared plant trait responses to the environment and effects on ecosystem properties in the context of two agricultural landscapes in a temperate and Mediterranean biome. To determine these trait–environment relationships, this study was conducted at field, pasture, and heathland sites forming a strong land use gradient in Northwest Germany and Israel. We used RLQ multivariate analysis and structural equation modeling (SEM) to evaluate the interactions between environment (disturbance, soil nutrients, soil water field capacity), plant traits (e.g. leaf traits, stem traits) and ecosystem properties (productivity, soil organic carbon) for the temperate and Mediterranean datasets. The response of stem dry matter content and leaf traits (community means and functional dispersion) to the environment and their effect on above-ground standing biomass were comparable in both biomes. Response-effect linkages to standing biomass could be generalized across the two biomes. The results underline the relevance of stem dry matter content and selected leaf traits in predicting the effects of land use on carbon pools and fluxes. On the other hand, we observed context-dependent results that preclude universal, linear response-effect relationships, particularly with regard to productivity and soil organic carbon. We found that traits of the most abundant species are the most important in determining effects on ecosystem properties, following Grime's mass ratio hypothesis. Functional diversity was of less importance, indicating that complementarity may only have subsidiary effects on standing biomass across relatively strong land-use gradients.

Inhibitory effects of *Bromelia pinguin* (Bromeliaceae) on soil ecosystems in primary forests of Costa Rica

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Vegetation has an important influence on the composition of microbial communities within soils. Due to the high biodiversity of flora present in tropical regions there are knowledge gaps regarding the ecological roles and impacts of many plant species on microbial community structure and nutrient dynamics. *Bromelia pinguin* (Bromeliaceae) is a terrestrial bromeliad commonly found under forest stands throughout the Neotropics. The bromeliad's fruit pulp possesses antifungal activity, raising questions on the possible effect of this plant on soil fungi and decomposition. A study in the lowland forest of Costa Rica showed the soil beneath these bromeliads had decreased fungal ITS DNA and differences in Carbon (C) and Nitrogen (N) levels compared to adjacent old growth forest. These belowground processes were investigated further showing that although the standing pools of dissolved organic C (DOC) and dissolved organic and inorganic N were similar in both soil types, the bromeliad soils had lower rates of C and N biomass development and less laccase activity (indicating decreased lignin degradation). Community level diversity and abundance of fungal ITS DNA, as determined by T-RFLP, was lower in bromeliad soils. Sequencing of fungal ITS DNA showed marked differences in fungal community structure between habitats, consisting of shifts in Basidiomycota (Tremellales, Agricales, Thelephorales), Ascomycota (Helotiales), and Zycomycota populations. These results provide information on the effect of this bromeliad on ecosystem function via shifts in the decomposer community. This naturally occurring microhabitat could provide a model for the impact of disturbance on fungal community structure and ecosystem condition.

The use of sustainable development practices to reconstruct tropical forests environments at El Bosque Nuevo in northern Costa Rica

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A major challenge in preserving Earth's biological diversity is to not only integrate accurate physical and biological data into sound conservation decisions but also to consider the dimension of human social interactions and conditions. Nowhere is this more evident than in tropical regions. As population expands and the pressure on natural resources development increases, new policies will have to be initiated to help conserve valuable resources. To date, progress to address this condition has been slow in coming and in most instances has not been treated as a priority in developing nations. Consequently, the destruction of tropical environments and countless species has advanced at a feverish pace. The Central American country of Costa Rica is unique in that resource conservation is treated as a national priority. The government pays landowners to keep property in an undeveloped state and encourages farmers to engage in sustainable development practices. This has helped to rejuvenate land that was abused by decades of overexploitation and development. Herein, we report on a sustainable initiative that employs the use of rearing butterflies, teak farming and organic shade grown coffee to help support indigenous farmers at the El Bosque Nuevo reserve in Costa Rica. The purpose of this initiative is to develop an income stream through the selective harvest of teak, establish and develop a plan to grow and market organic sustainably grown coffee and develop a productive and lasting relationship with rural Costa Rican farmers that will assure them a more profitable existence while conserving valuable biological diversity.

Microclimate of a light gap at the Amazon Conservatory of Tropical Studies (ACTS), Loretto, Peru: a five-year comparative analysis

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There is little known about the variable nature of light gap microclimates that occur in tropical rainforests. Light gaps are formed when tree fall events occur in forests owing to the natural aging process or other events such as storms and landslides. When this happens, understory plants rapidly begin to respond owing to the temporary exposure of light that they need to develop. To assess such conditions, we studied the microclimate of a light gap in a forest location in the Amazon Basin at the Amazon Conservatory of Tropical Studies (ACTS) near Iquitos, Peru. To obtain microclimate data, we assessed a 16 by 18m light gap by employing a series of data loggers that measured temperature and relative humidity. The loggers were strategically placed within the gap at 2m intervals from the center of the gap out in all 4 cardinal directions and in between each of these locations. Loggers were also placed 8-10 cm below the surface of the forest floor and at heights of 5 and 10m above the ground to further assess the vertical dimension of the forest. Photosynthetic available radiation (PAR) readings were taken each day for 4 consecutive days to assess this parameter at different times and during different weather conditions. Herein, we present a comparative assessment of a light gap analysis measured at select intervals in March over the past 5 years.

Woodland salamander responses to silvicultural practices within the Monongahela National Forest of West Virginia

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Recently, prescribed fire treatments have been used in the Appalachians to restore oak-dominated forests. Woodland salamanders are moisture- and temperature-dependent species that are potentially sensitive to changes in forest floor microhabitats resulting from prescribed burning. A recent West Virginia study indicated that in the short-term, woodland salamanders appeared somewhat tolerant of prescribed fires. However, fire-impacts on salamanders might take longer periods to manifest themselves and continued research is needed to fully understand impacts of fire in central Appalachian forests. The objective of this study is to determine if the application of silvicultural practices have longer-term effects on woodland salamanders in a mixed-oak forest. We conducted our study in the Canoe Run Watershed on the Fernow Experimental Forest in Tucker County, West Virginia, USA. We placed 3 coverboard arrays within 24 0.20-ha plots, where 20 of the plots were burned in 2002 or 2003, and again in 2005. During the dormant season of 2009-2010 a shelterwood harvest reduced the average overstory basal area from 33.29 m^2/ha to 14.23 m^2/ha. Surveys were conducted in May, July, and August 2011. Salamanders were identified to species with mass, snout-vent length, and total length being recorded. Twenty-four *Plethodon cinereus*, 17 *Plethodon glutinosus*, 16 *Desmognathus ochrophaeus*, and 2 *Eurycea bislineata* were captured for a total of 59 salamanders. Preliminary results suggest that the combination of prescribed fire and shelterwood harvest may affect salamander abundance. The findings from this study should aid in our understanding of impacts from silvicultural practices on the fauna of central Appalachian forests.

Temporal changes in stream detritivore communities are influenced by interaction between a dominant consumer and disturbance

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Patterns of temporal variability in ecological communities are due to both variations in aggregate and compositional community properties. Without understanding changes in both aggregate properties, like total abundance, and compositional properties, such as relative abundance, it is possible to misinterpret the mechanisms driving community variability. Changes in the patterns of temporal variability can be caused by biotic drivers, abiotic drivers, or an interaction between abiotic and biotic drivers. In this study, we manipulated the presence of a dominant detritivore (*P.gentilis)* and the presence of disturbance (drying) in a full factorial cage experiment. The study took place over 8 weeks in a headwater tributary of the Patapsco River in Maryland (USA). I quantified changes in aggregate community variability using coefficient of variation in total abundance and changes in compositional variability using the Euclidean distance traveled by the community in ordination space. We found that disturbance lowered aggregate variability, making the abiotic factor the driving force behind patterns of community variability. Compositional variability was lower in communities where *P.gentilis* was present, but only in the absence of disturbance. In the cages where both disturbance and *P.gentilis* were present, compositional variability was significantly higher, indicating an interaction between the biotic and abiotic drivers. In this system, both the presence of *P.gentilis* and our disturbance treatment tended to significantly change community dynamics.

Land management effects on soil nutrients, biomass, and fauna and fungal communities in Costa Rica

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Forty years of poor land management has caused damage to the lowland forests of Costa Rica, yet there is limited information on how these practices have impacted soil ecosystems. Development of secondary forests is now a common remediation strategy in the region, but how this practice has assisted soil recuperation is unknown. Few studies have examined the fungi and fauna of secondary forests, despite these biota providing functions of decomposition, detritivore activity, organic C and N nutrient scavenging, etc., critical to soil ecosystem development. In the Northern Zone of Costa Rica, soil fauna and fungal populations, and Carbon (C) and Nitrogen (N) cycle activities, were compared in adjacent unharvested primary, 18 year old secondary, and 28 year old grassland soils to investigate possible indicators of soil recovery from disturbance. Rates of dissolved organic C production, and amounts and rates of C biomass production were greater in primary and secondary forests, while rates of production of total N, and amounts and rates of N biomass production were greatest in primary and intermediate in secondary forests. These C and N data corresponded with a greater abundance of faunal groups Coleoptera, Collembola, Trichoptera, and Isoptera, and fungal groups Tremellales and Hypocreales in the primary forest, and Hemiptera and Helotiales in the secondary forest. This study suggests these metrics serve as good targets for potential use as indicators of environmental integrity in these soils due to the known role of these biota as decomposers/detritivores and functional importance in the C and N cycles.

A habitat model for the detection of red-backed salamanders at C. F. Phelps Wildlife Management Area, Fauquier and Culpeper Counties, Virginia

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Red-backed salamanders represent an important component of Virginia ecosystem health, but few habitat models that can reliably predict the presence/absence of this species. We surveyed the habitats of Red-backed salamanders and collected data on an array of habitat variables normally associated with them. We used logistic regression to develop a model predicting the presence or absence of the species at a given 50 m-transect. Our final model incorporated soil organic layer pH variability and mineral layer average pH, and accounted for 30% of the variation in our data. We conclude that soil pH is a limiting determinant of habitat use for this study site, perhaps due to historic gold mines in the area, and that it may affect adaptive behaviors for highly acidic soils.

Genetic analysis of populations of the cownose ray, *Rhinoptera bonasus*, in the Chesapeake Bay and Gulf of Mexico

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Cownose rays, *Rhinoptera bonasus*, are elasmobranchs found in the Western Atlantic from Brazil to Massachusetts. In the spring and early summer, large schools of rays migrate into the Chesapeake Bay to forage. The rays also utilize the Chesapeake Bay as a nursery for young-of-the-year pups and a breeding ground. During the summer, cownose rays migrate throughout the polyhaline portion of the Bay, but it is not currently known if these subgroups of animals are genetically isolated. In this study, we analyzed DNA sequence variation from portions of two variable mitochondrial genes, cytochrome b and cytochrome c oxidase I, in samples collected from two sites in the Chesapeake Bay (St. George Island, MD and Reedville, VA) and from Tampa Bay, FL. Preliminary results indicate that there is a statistically significant difference in the distribution ($p < 0.05$) of haplotypes between the two Chesapeake Bay populations as well as a difference between Chesapeake and Tampa Bay populations. Florida and Reedville share a haplotype that is present in substantial frequencies (34% and 23%, respectively); this haplotype is absent from the St. George Island population. These results suggest that the two Chesapeake locations attract different southern source populations each summer.

Analysis of private urban forest management in Bloomington, Indiana: A social-ecological systems (SES) perspective

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Urban tree cover in the United States is declining, decreasing the public benefits associated with urban forest ecosystem services. One explanation is that most urban trees are located on private property where households have few incentives to produce public benefits. From a social-ecological system (SES) perspective, institutional factors (such as municipal policies or neighborhood norms) can incentivize sustainable urban forest management (UFM), but the biophysical and social contexts are equally influential. Thus, we ask: What SES characteristics influence the structure and function of the private urban forest? What motivates households in the management of their urban trees? To answer these questions, we analyzed aerial imagery to classify canopy cover, sampled soils, and inventoried trees on 106 residential parcels in Bloomington, Indiana. Structural and functional tree analyses were performed and soil carbon/nitrogen (C/N) levels were determined per parcel. In addition, households on these parcels completed mailed questionnaires regarding their tree management. Preliminary results emphasize the influence of biophysical factors including age of housing development on private residential tree structure including parcel-level tree abundance, species richness, tree-infrastructure conflicts, and a parcel's average tree condition. Parcel-level tree abundance and evidence of tree maintenance were correlated with the number of invasive tree species on a property and tree maintenance occurred more often on parcels with fewer trees. The higher the proportion of trees maintained, the better the average tree condition per parcel. Ongoing data analysis will allow presentation of additional linkages between survey and biophysical data to identify the most relevant SES characteristics.

Seasonal colonization of *Hydra* in a South-Eastern Pennsylvania pond

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Hydra are well-known freshwater cnidarians but surprisingly, little is known about the parameters that govern population size and habitat specificity. In a previous study we showed that *Hydra viridissima* displayed a strong preference for shallow (~ 1 m) pond water habitats characterized by dense infralittoral vegetation. This study also found increased population densities in early spring sampling as opposed to summer and fall sampling.

In the current study, *Hydra* colonization rates were monitored from mid October 2010 to late December 2011. Six monitoring stations with multiple tiers of settling plates were positioned in a 0.2 hectare pond located in Millersville, PA (Roddy research pond). These stations were assayed every three weeks for colonization of *H. viridissima* and *H. oligactis.* In conjunction with these three week sampling cycles, zooplankton counts and several abiotic factors were measured weekly.

We found a low level (<20 total *Hydra*) of colonization from November to February, whereas in early March colonization had begun to increase (>100) with peak colonization in June (>1000). *Hydra* colonization was significantly correlated ($p<0.05$) with cladoceran, nauplii, and copepod populations. *H. viridissima* colonization was additionally correlated ($p<0.05$) with solar radiance while *H. oligactis* was not. A negative correlation ($p<0.05$) was observed between *Hydra* colonization and protozoan populations.

Mapping cultural ecosystem services: the case of freshwater recreational fishing in the Albemarle-Pamlico Basin

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Cultural ecosystem services – the aesthetic, psychological, spiritual, or recreational benefits people derive from nature – are important intangible contributors to human well-being, yet their current and future delivery are not well understood. Freshwater recreational fishing (FRF), a service enjoyed by around 25 million Americans, depends on biophysical and social aspects that vary geographically. We developed a framework for mapping delivery of FRF across the Albemarle-Pamlico Basin (APB) of Virginia and North Carolina. Our framework is based on distinguishing between the capacity for and the flow of FRF. We define capacity as how much FRF can be supported under certain biophysical (e.g. habitat suitability, water quality) and social (e.g. accessibility to people, site management) conditions. In contrast, FRF flow is the extent to which people actually take advantage of available fishing. Using publicly available data, we used water-quality status, water-body density, game-species occurrence, and riparian conditions to map biophysical capacity, and stream access and conservation status to map social capacity. We used FRF license data and 2010 Census Data to estimate flow. We created spatially explicit maps of FRF capacity and flow at the spatial resolution of 12-digit hydrological units and counties for the APB. Areas where capacity is high but flow is low suggest opportunities for promoting FRF. Conversely, areas where capacity is low but flow is high, suggest the need for site management to avoid service degradation. Our framework offers a novel way to understand the tradeoffs society makes among ecosystem services and among freshwater user groups.

Piecing together how soil organic matter dynamics influence the community structure of denitrification and DNRA organisms in tidal wetlands

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Wetland systems have the ability to mitigate anthropogenic nitrate loading via two main microbial nitrate reduction processes: denitrification (DNF), which transforms nitrate to dinitrogen gas; and dissimilatory nitrate reduction to ammonium (DNRA). Past work suggests the relative importance of each process is governed, in part, by soil organic matter (OM) characteristics; although the mechanisms underlying these relationships remain unclear. To address this question, we sampled ten tidal wetlands in the Chesapeake Bay watershed and examined the effects of OM breakdown on the structure of DNF and DNRA communities. Extracellular enzyme activity (EEA) assays were used to measure the degradation of both labile (β-1,4-glucosidase and 1,4-β-cellobiosidase) and recalcitrant (β-D-xylosidase and phenol oxidase) components of soil OM. EEA assays provide a sensitive measure of the quality and availability of soil OM for consumption by heterotrophic microbes, including DNF and DNRA bacteria. DNF and DNRA communities were evaluated for functional group abundance and community composition using quantitative PCR and genetic fingerprinting (TRFLP) respectively. Principal components analysis revealed signification relationships between EEA and soil OM characteristics (C:N and %OM). Mantel tests indicated DNF community composition was significantly correlated with labile carbon degrading EEA (1,4-β-cellobiosidase). DNRA community composition was significantly related to recalcitrant (β-D-xylosidase, phenol oxidase) and labile (β-1,4-glucosidase) OM degrading EEA. These results suggest DNF and DNRA communities may be reliant on different types of OM for respiration. Understanding the regulation of DNF and DNRA is important as the balance determines whether reactive N stays in the ecosystem (DNRA) or exits as N_2 (DNF), preventing downstream eutrophication.

Environmental controls on the abundance and activity of ammonia oxidizing bacteria and archaea in temperate forest soils

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Ammonia oxidation is the rate-limiting step of nitrification, a critical process, which controls inorganic nitrogen mobility in soils. Ammonia oxidation is performed by two major groups of chemoautotrohpic microorganisms: ammonia oxidizing bacteria (AOB) and recently discovered ammonia oxidizing archaea (AOA). We investigated the effects of disturbance history and edaphic variables on the abundance and activity of AOA and AOB at Coweeta Hydrologic Laboratory, a long term ecological research site in western North Carolina. In an initial study, we found high abundances of AOA, relatively lower abundances of AOB, and a negative relationship between soil pH and AOA abundance. These results contrast with later investigations into the activity of these organisms, which revealed a positive relationship between soil pH and net nitrification, as well as an increase in abundance of AOB during field nitrification incubations. Though AOA outnumber AOB by two orders of magnitude in this system, our results indicate that AOB may play a large role in nitrification at Coweeta. Ongoing work will determine which edaphic variables control AOA and AOB activity, leading to a better understanding of niche-differentiation between these phylogenetically-disparate members of the functional group of ammonia oxidizing microorganisms.

Modeled impacts of land cover change on greenhouse gas emissions in the Roanoke Valley, Virginia

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Changes in land cover, an often-overlooked aspect of regional sustainability initiatives, have the potential to significantly impact CO_2 emissions and offset existing efforts to reduce anthropogenic greenhouse gas (GHG) emissions and increase carbon sequestration. This study examines recent land use changes in the Ridge and Valley eco-region of Southwestern Virginia (including the cities of Roanoke and Salem and Botetourt, Franklin, and Roanoke counties) to assess the relationship between developmental trends along the urban-to-rural gradients and regional GHG emissions. Estimates of the pattern and rate of land cover change were derived from satellite imagery data collected for regular intervals dating from 1992-2011 (National Land Cover Dataset; USGS). Quantitative data associated with the conversion of forests and grasslands to developed areas was then calculated, and estimates were then correlated with U.S. Census population growth data and new development in the region. The impact of historical and projected growth and urbanization on GHG were modeled using current NASA CO_2 emissions data (Vulcan) and published correlations between land use conversion and population densities to GHG emissions. In order to gain a more complete understanding of the changing GHG emissions and their link to population/population density, per capita CO_2 emissions for residents of each county are being calculated for the 20 year study interval. Models of GHG emissions, development trends, and population density will be evaluated to quantify historical and predicted impact of land development on regional GHG budgets. The ultimate goal of this research is to provide managers and decision-makers with a point of reference for the potential impact of planned development on regional GHG emissions.

Environmental factors influencing the distribution of *Leptospira interrogans* in soil and surface waters using quantitative PCR

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Leptospira interrogans is a gram-negative spirochete bacterium that is the main cause of Leptospirosis, a zoonotic disease that can cause renal failure and multiple organ failure in humans and some animals. While *L. interrogans* occurs primarily within mammalian hosts, it is often found as a free-living bacterium in soil and freshwater environments. The factors that control the distribution of this important pathogen in soil and water environments remain unclear, however. This study investigates the effects of land-use on the abundance of *L.interrogans* in soils and adjacent aquatic environments in Southwestern Virginia, including an organic farm, a public dog-park, and a forested head-water catchment in the Jefferson National forest. Stream-water sampling sites were located adjacent to the soil sampling sites, to investigate the effects of hydrologic connectivity on the distribution of these organisms during base-flow and storm-flow conditions. These sites vary in potential host (i.e., deer and domestic dogs), density and traffic, as well as edaphic variables such as moisture content, pH, conductivity, organic carbon content, and inorganic nutrient content. At each site we estimated the abundance of *L. interrogans* by quantitative polymerase chain reaction (qPCR) using published primer sets specific to a ribosomal protein of *L. interrogans* serovars, and measured soil and water properties by standard methods. Here we report the first description of land-use, geochemical and hydrological influences over the occurrence and distribution of the pathogen Leptospira interrogans in soil and surface water environments of Southwestern Virginia.

Pre-restoration stream data for amphibian populations at Big Spring Run, Lancaster County, Pennsylvania

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In order to improve the ecosystem services provided by a stream in an agricultural landscape, a consortium of scientists, state and federal officials are conducting an experimental stream restoration project in which legacy sediments are removed. The intent is to return Big Spring Run, PA to a condition similar to that of pre-European settlement. Our study focuses on the pre-stream restoration status (spring/early summer 2011) of amphibian populations, specifically frogs and salamanders. To assess and identify the presence of frog species at Big Spring Run, frog call recordings were collected for 30 minute intervals at dusk and dawn during the spring and early summer months and are currently being analyzed using the program SongScope. Salamander data were collected using four capture techniques (litterbags, kick nets, dip nets, and manual capture) in four branches (Main, West, East, and Kennel) of Big Spring Run. Kennel Branch served as a control stream as it is not part of the restoration. Of the three salamander species identified, 97.3% were *Eurycea bislineata*. The dip net method yielded the most salamanders, but variation existed between the species caught and the capture method. Data collection following the removal of legacy sediment will be necessary to determine the impacts of the restoration on frog and salamander populations.

Competition between IUCN, near-threatened, red-bellied turtles (*Pseudemys rubriventris*) and invasive red-eared slider turtle (*Trachemys scripta elegans*)

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Invasive species affect populations and communities of wildlife worldwide through predation and competition for limited resources. Globally, the invasive red-eared slider turtle (*Trachemys scripta elegans*) may compete with native turtles for limited food, basking and other wetland resources. In the mid-Atlantic region of the United States, the red-eared slider turtle is ecologically similar to the red-bellied turtle (*Pseudemys rubriventris*). Red-bellied turtles have undergone population declines in wetlands where red-eared slider turtles have been introduced. In anthropogenically degraded wetlands the potential for competition may be greater between red-eared slider turtles and red-bellied turtles due to extensive overlap for dietary resources and habitat use. We performed manipulative experiments with juvenile turtles of both species to determine the underlying mechanisms of how red-eared slider turtles may compete with red-bellied turtles for limited resources. Using mesocosms, we housed single and mixed species groups at low and high densities to determine the mechanisms of competition for limited dietary and thermoregulatory resources. We determined ingestion rates, growth rates and behavioral interactions of turtles to determine whether red-eared slider turtles outcompete red-bellied turtles for limited dietary and thermoregulatory resources. Preliminary results indicate that the two species feeding together have greater ingestion rates than either species feeding alone. Understanding the mechanisms of competition between red-eared slider turtles and red-bellied turtles will allow us to understand the long term impacts of the red-eared slider turtle invasions on ecologically similar native species.

Nest association strength influences patterns of rarity and commonness in New River, Virginia cyprinids

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Many North American minnows (Cyprinidae) exhibit nest association, a spawning mode in which one species (associate) uses nests constructed by another species (host). Although this relationship may be obligate for some species, many nest associates use alternative reproductive modes, indicating that the strength of the relationship may vary. Quantifying nest association strength is a first step for understanding the importance of this interaction to stream fish communities. To do so, we conducted a literature review of ecological and ethological reproductive traits for 11 associates of *Nocomis* occurring in the New River basin, Virginia. We detrended traits from the effects of phylogenetic relatedness among species, and ordinated a phylogenetically independent trait similarity matrix of the 11 species to delineate groups of strong and weak nest associates. Strong nest associates showed significant geographic range overlap with *Nocomis*, while weak ones did not. No difference in spawning temperature range overlap occurred between the two groups. We tested for effects of nest association strength on species' rarity, and found that most (6 of 7) strong nest associates held rare classifications based on one or more of geographic extent, habitat breadth, or local abundance. Conversely, all weak nest associates reflected common classifications. These results indicate that nest association strength is related to rarity; this potentially crucial aspect of conservation has been previously overlooked. Clearly, conservation of rare and imperiled nest associates should be pursued through protection of their host and, consequently, the mutualism they have evolved to exploit.

Assessing construction-induced cohesive soil compaction in urban green spaces

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High levels of construction-induced compaction occur in urban green spaces because cohesive soil sub-grades are compacted to 95% or more of optimum Proctor density determined by the standardized ASTM test. This practice, rooted in customary engineering practice for preparing soil foundations, is applied to the construction of urban green spaces without consideration of environmental impact or intended agronomic and recreational uses. The urban green space maintenance industry uses costly equipment and practices to mitigate compacted urban green spaces. The current work sought to use air permeability as a measure of construction-induced compaction in order to develop ex-ante 'prevention-rather-than-cure' design and construction practices versus ex-post efforts to mitigate compaction of these soils. A portable transient flow apparatus was designed for rapidly measuring air permeability, and was used to measure air permeability on Proctor test specimens of three cohesive soil materials. Test specimens were compacted at their Proctor optimum water content with efforts ranging from 100 % to 25% of that used in the standardized Proctor test. Results confirmed that compaction severely reduces air permeability of the test specimens, and indicated that the common practice of compaction to 95 % or more of the optimum Proctor density is probably not appropriate for construction of urban green spaces. Reducing compaction effort from 100 % to 25 % of the standardized Proctor test value increased air permeability 30, 89, and 42 times respectively for the loam, silt loam, and silty clay test specimens.

Seed production, germination, and morphological traits for *Vallisneria americana* crosses occurring within and among two geographic regions: Implication for managed relocation

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Concern about climate change's impacts on species across a latitudinal gradient continues to increase within the ecological community, particularly species who have limited dispersal capabilities. Managed relocation, or the intentional movement of species from an area of current occupancy to an area that is likely to have conditions favorable for future persistence, has been proposed as a restoration strategy to manage biodiversity in the face of climate change. However, it is unclear how restoration efforts should proceed. Local populations may be better adapted to their environment, and introduction of non-local genotypes may lead to genetic dilution and outbreeding depression. In contrast, mixing of local and non-local populations of the same species can increase genetic diversity and adaptability. This study aims to answer this question for *Vallisneria americana*, a submersed aquatic plant found along the Atlantic coast, by looking at germination success and growth capabilities. Data was taken from seed stock produced by crosses within and among populations from Florida and the Chesapeake Bay. Sexual reproduction is possible for genotypes collected from such disparate regions, and furthermore, there are no significant differences in seed production between those individuals of mixed genetic material and those whose parents were sourced locally. In addition, germination trials and growth rates are being assessed for the crossed individuals.

Carbon sequestration by trees on the campus of Elizabethtown College, Pennsylvania

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Carbon sequestration is the process of capturing carbon from the atmosphere and storing it for long periods of time in a carbon sink. Trees sequester carbon through the process of photosynthesis by taking carbon dioxide from the atmosphere and storing the carbon in its biomass. The purpose of this study was to measure the amount of carbon sequestered in the trees on the suburban campus of Elizabethtown College, PA. In the fall of 2011, we measured the diameter at breast height (DBH) for the 755 trees planted on campus. These trees represent 30 species. We are currently using species-specific allometric equations, obtained from the literature, to calculate the aboveground biomass of each tree and will then convert that value into mass of carbon. The ability of trees to remove carbon from the atmosphere and store it for a relatively long time could be environmentally beneficial in light of current elevated levels of carbon dioxide in the Earth's atmosphere and the resulting changes in climate. The results from this study will be used by Elizabethtown College to determine how much of its carbon emissions are currently sequestered by trees on its campus.

The influence of biophysical factors on the growth and mortality of young urban trees

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This study aims to address the limited understanding of the impacts and relationships between multiple biophysical factors on the growth and mortality of young urban trees. Additionally, this study begins to address the need to assess urban tree growth and mortality across a range of urban planting sites and at a species-specific level. Analysis is based on a census of 1474 community planted trees (ages 4-16) in New Haven, Connecticut. Growth parameters measured include diameter (dbh), tree height, live crown dimensions, and crown volume (m^3). Biophysical factors are based on in-field measurements and spatial analyses, which occur at different scales.

Preliminary analysis examined growth rate index (dbh/age) and crown volume (m^3). Biophysical factors had little effect on the population as a whole. However species-specific analysis of variance and regression modeling demonstrates significant interactions across multiple factors. Site characteristics had little effect on the growth of ornamental species. The growth of all shade trees (*Acer spp., Quercus spp., Pyrus spp., Tilia spp., Gleditsia triachanthos, Zelkova serrata*) were significantly affected by site typeology ($p < 0.076$) neighborhood ($p < 0.09$), percent impervious cover at the parcel scale ($p < 0.05$), proximal canopy cover at parcel scale ($p < 0.05$), and building setback ($p < 0.009$). Multiple regressions increased the strength of these relationships: percent canopy cover and percent imperviousness significantly influence 44.6% of the growth of *Zelkova serrata* ($R^2 = 44.6\%$, $p = 0.022$ & 0.069). Further analysis will consider similar multiple regressions and interactions at a species level.

Habitat use by suburban white-tailed deer along disturbance gradients

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White-tailed deer populations have increased dramatically in suburban areas of the northeast, reportedly due to disturbance that creates forest and field patches. For this study, two dozen deer were radio-tracked in a suburban area 20 km northeast of Philadelphia with high-frequency fixes (5 minute intervals) over several weeks to several months each. The high-frequency tracking provides more precise data regarding deer movement and deer habitat preferences compared to traditional studies. Several approaches were used to rank habitat disturbance in the study area. One metric is based on land use (scale 0-10), with zero corresponding to open protected forest areas and 10 to paved industrial areas. The second metric is based on the probability of vegetation succession to occur (scale 0-5), with zero indicating areas where succession is almost impossible (paved roads, buildings) to areas rated a five where vegetation succession is now occurring. Habitat is additionally classified by the density of human occupied buildings. A GIS model was developed depicting habitat disturbance scores by GPS fixes generated by individual deer. The monitored animals clearly preferred wooded habitat with shrubby underbrush, untended land, and fields with annual and bi-annual mowing regimes, although deer preference was highest for patches of young forest. These high density data in a suburban area support the prevailing understanding of deer population dynamics in disturbed areas, and suggest that the presence or absence of vegetation succession is a determining factor affecting deer habitat choice. Managing succession in these areas could be instrumental in controlling white-tailed deer populations.

Microhabitat of flatwoods salamander egg deposition sites

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The endangered reticulated flatwoods salamander (*Ambystoma bishopi*) is one of two flatwoods salamanders that occur in the southeastern longleaf pine ecosystem. Both are experiencing population declines mainly attributed to habitat loss and degradation. These salamanders deposit eggs on dry land in ephemeral wetlands, and the eggs typically hatch from inundation by rising water levels. During the 2011-12 winter breeding season, we described microhabitat characteristics of *A. bishopi* egg deposition sites from two ephemeral wetlands on Eglin Air Force Base, Florida. We estimated vegetation cover in 10 cm^2 plots for 59 egg deposition sites (used) and in paired random sites without eggs located 1-3m from each deposition site. Percent cover provided by plants with a forb/herb growth habit (including *Eriocaulon compressum* and *Xyris spp.*) was significantly greater at egg deposition sites (39%) compared to random sites (23%), while percent cover from plants with a graminoid growth habit (e.g., *Aristida spp.*, *Dichanthelium spp.*, *Rhynchospora spp.*), litter, and bare ground were not significantly different. Additionally, shrub cover was greater at random sites (4% compared to 3%). Because *Eriocaulon compressum*, *Xyris spp.*, and *Dicanthelium spp.* appeared to be abundant near most clutches, we also measured their densities in the plots. *Eriocaulon compressum* and *Dichanthelium spp.* densities were higher in used sites. At many potential breeding wetlands, a history of fire suppression and other anthropogenic changes appear to have modified the habitat. We will use knowledge of habitat selection by flatwoods salamanders in creating restoration and management strategies that account for microhabitat features within wetlands.

Dung beetles (*Coleoptera: Scarabaeidae* and *Geotrupidae*) communities of Eastern Maryland

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We examined the species diversity and seasonal abundance of 19 species of dung beetles (*Coleoptera: Scarabaeidae* and *Geotrupidae*) in two ecotone habitats of Maryland's Eastern Shore. Specimens were collected over an eight-month period during 2009–2010, using standard pitfall trap transects of 200 m. In 2010, an additional survey of eight habitats in Wicomico and Worcester counties was conducted to obtain a more representative sample of the original dung beetle diversity. Habitat data, bait attraction, and collection methods are provided. This research is intended to be the first bioinventory of Maryland dung beetles for conservation research.

Landscape heterogeneity of airborne Hg (mixed dissolved, particulate and vaporous) and corresponding Hg concentration in *Prunus* sp. leaves within Rockingham County, Virginia

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Heterogeneous distribution of airborne Hg is known to occur at the landscape level. Passive air samplers consisting of inverted plastic Petri plates containing Tangle Trap (a sticky organic material) had been developed previously to examine contamination patterns at dozens of locations. The atmospheric samplers accumulate dust, Hg vapor, and Hg dissolved in precipitation over a fixed period of exposure, which is measured in $mg \bullet m^{-2} \bullet day^{1}$. The assumption is that this serves as a relative contamination index, comparable during this interval, for different locations in the landscape. The total Hg content from exposure to the air over 4 mo ending in November was measured through acid digestion and atomic absorption spectrophotometry. There was considerable landscape variability and several samplers located in areas isolated from human activity acquired virtually no Hg. Five contaminated sites, which had consistently above average Hg concentrations previously, and a low Hg control location, were selected for more extensive study in 2010 and 2011. In this paper we report the relative Hg concentration in the air samplers and compare those data with the accumulated Hg concentration in cherry (*Prunus* sp.) leaves in November of 2010 and 2011 just before leaf fall. Being deciduous, the leaves acquire Hg over a single growing season. In 2011 the Hg content of the leaves in July was compared with that in November to assess change over the period. Generally, more Hg was associated with *Prunus* leaves at the sites previously identified as having more airborne Hg than the low Hg control.

Exotic invasive species on the Richard Stockton College campus, 1970-2012

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In 1970, before construction began at newly-founded Stockton State College in Galloway Township, New Jersey, Jack McCormick, a noted student of the Pine Barrens, was commissioned to conduct an ecological inventory of the campus site. His report contains a detailed list of the plant species then growing within the campus boundaries. At the time, twenty-seven residential sites existed on the campus and McCormick noted that most had been landscaped with non-native trees, shrubs and herbs and provided a list of the plantings at each of the sites. In 2010 and 2011, students for the spring semester Ecological Principles Lab class at Stockton surveyed current populations of exotic invasive plant species, with particular attention to shrubs and woody vines. GPS mapping and comparison to historic aerial photos indicates that the heaviest concentrations of invasives, both those noted in McCormick's study and those that appear to have arrived on the campus since 1970, are in the areas described as agricultural, old field or residential sites in the 1970 report and along the margins of the former cranberry bog impoundment, Lake Fred. Ecology students are continuing the investigation in 2012, attempting to determine whether alteration of soil pH or other properties has been a key factor in the establishment of invasives and whether the College's failure to follow McCormick's advice to restore the former pig farms and residential sites to native vegetation types has been a factor in their persistence.

Use of automated radio telemetry to detect nesting activity in ornate box turtles

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Miniature data loggers and transmitters allow biologists to efficiently study wary or cryptic animals in their natural habitats with minimal disturbance. In the spring-summer of 2010 and 2011, we investigated whether automated radio telemetry and the signal change method could be used to study the activity and nesting patterns of ornate box turtles (*Terrapene ornata*) inhabiting a sand prairie in northwestern Illinois. The signal change method relies on the principle that any movement of a radio transmitter (including minor changes in orientation) can strongly affect the intensity of the transmitter's signal at a stationary receiving station. Using video recordings of radio-monitored turtles, we confirmed that transmitter signal strength values can be analyzed to generate accurate indices of box turtle activity patterns. Notably, during the 2010 nesting season, most of 19 monitored females exhibited substantial activity on one or more nights. Previous reports indicate that ornate box turtles nest at night, but are otherwise inactive after dark. Based upon this information, relatively little indication of night activity by males, and other patterns present within the radio signal recordings, we hypothesized that night activity corresponded to nesting. We visually confirmed nesting in 3 night-active females in 2010 and also used the method to locate 13 nests in 2011. The night activity recordings and visual observations suggest that females may often require multiple nights to successfully nest. In conclusion, we demonstrate that the signal change method can be used to efficiently identify box turtle nesting activity with minimal disturbance to study animals.

The effects of land management, pollination, and density dependence on the survivorship and fecundity of *Gentiana autumnalis*

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Gentiana autumnalis is a rare, early succesional flowering plant species that is endemic to pine barren habitats. Early successional habitats are created by wildfires in a cycle of no more than 15 years between burns in some pine barren habitats. Due to anthropogenic fire suppression, most early succesional habitats are now located along roadsides that are managed by local municipalities. These roadsides are often left unburned and instead mowed to reduce the encroachment of vegetation onto the roadways. The specific aim of this study is to classify patches of *Gentiana autumnalis* by their areal size, density, density of co-flowering plants and land management strategy used. Demographic data such as survivorship, fecundity, and recruitment will be recorded for each site. These data will elucidate whether a given patch is increasing or decreasing in size over succesive seasons. In addition, pollinator visitation rate will be recorded for each patch along with fidelity and observed seed set in order to determine at what patch density and management strategy is visitation rate and seed set maximized. Identifying which management strategies and population densities maximize survivorship and fecundity will be important for ensuring the viability and management of rare plant populations such as *Gentiana autumnalis*.

Pollinator accessibility and connectivity of the flowering dogwood (*Cornus florida*) across an urban landscape gradient

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Urbanization greatly alters the physical and functional aspects of an environment, including floral and faunal interactions. Pollinator mobility in urban environments may be limited or assisted by the structural composition of urban areas, potentially affecting pollination rates of insect-reliant flora and subsequently impacting the genetic connectivity of populations not only within urban settings but also between urban and rural plant populations. The interaction of plants and pollinators in the context of urban environments is still not fully understood despite growing research interest in the area of urban ecology. This study uses a Flowering dogwood (*Cornus florida*) population in the urban setting of Richmond, Virginia to assess the impacts of urban structural elements on the movement and accessibility of pollinators. We studied pollination success and seed set of dogwoods along an urban gradient from Richmond to Charles City County. Preliminary data show that urban dogwoods had a significantly higher pollination success rate than those in the rural environment. Spatially explicit analyses of reproductive success show a positive correlation with floral propinquity, while alternately responding negatively with proximity to existing physical structures within the urban environment. These results suggest that local ecological context has the ability to significantly influence the population fitness and persistence of this ubiquitous understory tree.

Species diversity and the succession of dung beetles to horse dung on Assateague Island

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Scarabaeinae dung beetles are an ecologically and economically important group of insects. Their benefits include, but are not limited to: nutrient cycling, use as biodiversity indicators, removal of dung, and removal of agricultural pests. The aim of the study is twofold: 1) Examine the species diversity of dung beetles on Assateague Island; and 2) Compare the succession of dung beetles feeding on horse dung on Assateague Island to beetles feeding on horse dung on the mainland. Because of the harsh environment of the island, lower species diversity is expected to occur than on the mainland environment in Worchester County, MD. Baited pitfall traps were used to determine species diversity on the Island. Succession of beetles attracted to horse dung was accomplished using pitfall traps baited with horse dung and collections were made on days 1, 3, 5, 7, 14, and 21. 7,997 individuals comprised of nine different species have been collected during the species diversity study so far. For the succession study, 145 individuals as eleven different species were obtained on mainland horse farms, and eight different individuals of three different species were found in the horse dung pitfalls on the island. Sampling will occur during 2012 to confirm these results.

The role of whitebark pine facilitation and blister rust mortality in treeline community development, Northern Rocky Mountains

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At alpine treelines on the eastern front of the northern Rocky Mountains, whitebark pine (*Pinus albicaulis*), a keystone species, generates vegetation pattern by apparent facilitation of tree island communities. White pine blister rust, caused by the invasive fungal pathogen *Cronartium ribicola*, threatens this process by killing whitebark pine. Given the increased importance of facilitation in areas of high abiotic stress, we are interested in determining if and how 1) the role of whitebark pine as a tree-island initiator, and 2) mortality of whitebark pine, varies with environmental and topographic variables (elevation, slope angle, solar radiation, slope aspect, and flow accumulation) at two treeline study areas in Montana, USA (Divide Mountain, and Wyoming Creek) and one treeline study area in Banff National Park, Alberta, Canada (Parker Ridge/Hilda Gulch). At a total of 80, 15m x 15m sampling plots, we mapped the distribution of living and dead whitebark pine trees, (N=1160), and recorded blister rust canker density. Using general linear mixed models and nonparametric tests, we found whitebark pine to be important in tree-island development at the two, generally dry, sites in Montana. However, the importance of its facilitative role decreases on northwest-trending slopes, where conditions are generally moister than on east-trending slopes. Additionally, we found that different factors influence mortality of whitebark pine in tree-islands (aspect and blister rust) compared to solitary trees (slope and elevation). Overall, variability in local site factors, especially those that influence site moisture conditions, appears to play an important role in treeline community dynamics.

Dendrochronology-based fire history of mixed pine-oak forest on Warm Springs Mountain, Virginia

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Warm Springs Mountain (WSM), a major conservation target for The Nature Conservancy in Bath County, Virginia, is home to a rare montane pine barren and large tracts of uninterrupted deciduous forest. A lack of knowledge of fire regimes and impending climate change represent serious management challenges for these ecosystems. The only published study at WSM shows an absence of pitch pine (*Pinus pungens)* regeneration and increase in non-pine/oak species in recent decades at the pine barren and is probably linked to fire suppression. Dendrochronological studies of fire history are rare in the southern Appalachians including Virginia. A study of pitch pine stands on dry southwestern slopes about 40 km from WSM indicated ~7 year fire return interval (Aldrich et al. 2010) but the more mesic slopes are undocumented making fire management difficult. This study documents fire history and its effects on vegetation on southeastern slopes on WSM using dendrochronology and vegetation sampling. We studied trees in four 20x50m plots to develop a tree ring chronology and document changes in stand composition and structure through time. We are analyzing cross-sections from living and dead stems inside and near the plots to reconstruct fire history. Fire return intervals on the more mesic southeastern slopes of WSM is expected to be longer than on the southwestern slopes previously studied. We found an increase in fire-intolerant species and decline in fire resistant pines and oaks through time. A clearer picture of fire/vegetation dynamics over space and time will provide insights to fire management policies.

Landscape heterogeneity of airborne Hg (mixed dissolved, particulate and vaporous) and a sampling of total Hg concentration in micro-invertebrates within Rockingham County, Virginia

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Heterogeneous distribution of Airborne Hg is known to occur at the landscape level. Passive air samplers consisting of inverted plastic Petri plates containing Tangle Trap (a sticky organic) have been used since the last decade to examine this pattern. The assumption is that this deposition serves as a relative index ($mgHg \bullet m^{-2} \bullet day^{-1)}$ comparable for different locations in the landscape. The Hg content when exposed to the air over a fixed period was measured. There was considerable Hg variability and several samplers located in areas isolated from human activity captured virtually no airborne Hg in the samplers. Five contaminated sites, which had consistently above average Hg concentrations, and a low Hg control, were selected for more extensive study in 2010 and 2011. In addition to dust, Hg vapor, and Hg dissolved in precipitation, the Tangle Trap captures various micro-invertebrates and debris. All items greater than approximately 0.5 mm in diameter were routinely removed to 'clean' the plates. In this paper we report a comparison of the relative Hg content of the air dried micro-invertebrate tissue (mostly insects) to the relative airborne Hg measured by the plate samplers. The results were that with one exception, both the airborne and insect Hg content of the five sites previously having elevated Hg ranged from 2 - 7X greater than the control site. This supports the presence of a repeatable pattern of distribution of low level Hg contamination consistent between airborne and micro-invertebrate deposition.

Implications of early life histories on competition between virile and rusty crayfish in the Monocacy River, Maryland

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Rusty crayfish (*Orconectes rusticus*) are currently displacing the virile crayfish (*Orconectes virilis*) in the Monocacy River. Our research examined young of the year life history traits of both crayfish species to identify potential mechanisms of competitive dominance and eventual displacement of *O. virilis*. The distribution of species along Monocacy River provided a unique location to investigate young of the year (YOY) life histories in the presence and absence of inter-specific competition. We sampled at sites dominated by *O. rusticus* and *O. virilis* respectively, and at a site where both were present and in direct competition. In competition with *O. rusticus*, *O.virilis* experienced higher mortality, reduced growth rate, and smaller year-end size than compared to the virile dominant site. The *O. virilis* population also had a large YOY collapse of its juvenile population by early summer in competition, but this was not observed at the *O. virilis* dominant site. This suggests that displacement of *O. virilis* by *O. rusticus* is occurring in the juvenile age class. *Orconectes rusticus* juveniles showed increased growth rate and larger year-end size at competition sites than at *O. rusticus* dominant sites suggesting the invasion front may provide juvenile *O. rusticus* new resource availability. *Orconectes rusticus* mortality was unchanged by the presence of the virile crayfish.

Seedling establishment from experimentally planted seeds of an economically important African tree

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Allanblackia stuhlmanni (Clusiaceae) is a rainforest canopy tree with large seeds that can be pressed for vegetable oil. A growing international market for Allanblackia seed oil has spurred harvesting of seeds from protected forests in the Amani Nature Reserve, East Usambara Mountains, Tanzania. If the level of seed harvest is unsustainable, it could affect the dynamics of giant pouched rats (Cricetomys gambianus) which scatterhoard Allanblackia seeds. A possible mitigation plan could involve direct sowing of seeds. We followed seed fate (until disappearance) for 960 total Allanblackia seeds planted in twelve different plots throughout the Nature Reserve in two rounds of 480 seeds each. A continuous time Markov state space model is used to estimate the transition probabilities between different seed fates as a function of covariates, such as: temporally-varying fruit abundance, total fruit abundance, and seed mass. Preliminary results indicate that larger seeds have higher probabilities of germinating and establishing. Temporally-varying fruit abundance is a better predictor than the total fruit abundance, but results from a Cox proportional hazard regression suggest that the effect is the opposite of what we expected (seeds are more likely to go missing when there are higher numbers of fruits). The hazard of going missing after being planted increases with seed mass. The results of this study will be used to inform future research on Allanblackia regeneration and management strategies to ensure sustainable seed harvest.

Bacterial community dynamics along a developing coastal sand chronosequence

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Organism succession during ecosystem development has been relatively well studied for aboveground microbial communities while the associated pattern of change in microbial communities remains largely unknown. We initiated a study along a developmental sand-dune chronosequence bordering northern Lake Michigan at Wilderness State Park with the hypothesis that the soil bacterial communities will follow a pattern of change that is associated with soil, plant, and ecosystem development. This study site included 5 replicate sites along 9 dunes ranging in age from 95 to 4000 years since deposition. The microbial composition and diversity in the soil was studied using bacterial tag-encoded FLX amplicon pyrosequencing of the 16S rRNA gene. As hypothesized Bray-Curtis ordination indicated that bacterial community assembly changed along the developmental gradient. However, there was an effect of season in the younger but not older dunes. Soil Ca, Mg levels and pH showed a significant log-linear correlation with the soil development ($r \sim 0.83$, 0.84 and 0.81). Bacterial diversity represented by Simpson's reciprocal index (Simpson's 1/D) showed a steady decline from youngest to the oldest dunes with largest decline (212 to 58) during the initial stages of soil development (95 to 440 years). The change in plant species abundance was higher in the youngest sites than the older sites. This change was significantly correlated with the change microbial community distribution ($p<0.000001$; $r=0.56$). The results suggest that soil pedogenesis and gradients in soil pH, soil nutrients and plant community composition are associated with shaping bacterial community assembly as ecosystems develop and mature.

Forest structure, nutrient dynamics, and *Pentaclethra macroloba* growth following deforestation in Costa Rica

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Succession following deforestation in lowland Neotropical forests has been investigated for almost a century, yet rarely have studies connected nutrient dynamics with vegetation. This study was conducted in lowland wet forests of Maquenque, Costa Rica. The objectives were to characterize nutrient dynamics in regenerating forests and existing primary forests to link with vegetative diversity and evaluate the role of *Pentaclethra macroloba* in forest regrowth. In 2008, we established four 20m x 15m plots in primary and secondary forests in areas where *P. macroloba* was the dominant N-fixing tree. Soil and vegetation data were collected from 2008-2010. We found indicators of nutrient cycle activity were generally higher in primary stands than in secondary forest stands. Primary forest soils were greater in percent of water, phosphate, NO_3 and TMN levels, use of organic C, C biomass, and respiration rate. This trend corresponded with higher richness, biomass, and cover of total and leguminous plant species and understory biomass in the primary forest. In the secondary forest, the density of *P. macroloba* seedlings above 1m tall was greater, as was the density of adult *P.macroloba* in the study area. In the primary forest, however, adult *P. macroloba* were greater in volume than in the secondary forest. This research illustrates the importance of *P. macroloba* in secondary forest stands as the primary N-fixing species and documents effects that this tree appears to have below-ground. We believe trends that were found can be used as indicators of success in tropical wet lowland forest restoration and management.

Physiological strategies of three co-occurring temperate shrub species: responses that enhance invasibility

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Physiological traits of plants may be an important factor that helps explain invasibility in a given habitat due to relationships between physiological responses, growth and resource utilization. The primary objective of our study was to characterize physiological strategies of three co-occurring shrub species, *Elaeagnus umbellata*, *Clethra alnifolia*, and *Vaccinium corymbosum*, the first of which is invasive, in order to determine which physiological traits enhance invasibility. Several water relations parameters were measured including hydraulic conductivity, stomatal conductance, and leaf and stem xylem pressure potential. In order to estimate photosynthetic yield, light-adapted rapid light curves were measured on fully expanded, sunlit leaves using a pulse amplitude modulated leaf fluorometer. Maximum specific conductivity was highest for *E. umbellata* and significantly different among species. At midday, *E. umbellata* showed a 56 ± 8 % loss of conductivity compared to 29 ± 3 % for *C. alnifolia*, and 13 ± 5 % for *V. corymbosum*, yet it still had a similar or higher *in situ* specific conductivity as *C. alnifolia* and *V. corymbosum*. Further, midday stem pressure potentials were not significantly different among species (~ -1.3 MPa), indicating that *Elaeagnus* is the most vulnerable to cavitation. The electron transport rate (ETR) of sun leaves of *E. umbellata* was substantially higher than either *C. alnifolia* or *V. corymbosum*; however, shade leaves of *C. alnifolia* and *V. corymbosum* displayed higher ETRs than *E. umbellata*. *Vaccinium corymbosum* displayed hydraulic architecture that should support higher rates of ETR than *C. alnifolia*, but this was not observed for sun leaves, suggesting another limitation in light response. The invasive shrub *E. umbellata* displayed an enhanced capacity to respond to a higher light environment than either *C. alnifolia* or *V. corymbosum*.

Community and population-level responses of an Afromontane chameleon assemblage to forest fragmentation

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Habitat modification in the form of fragmentation and loss is a leading cause of biodiversity decline. The basic predictions from island biogeography theory that species richness and population size decrease with declining area and increased isolation have received considerable support. However much of this research has focused on birds and mammals in temperate regions or the Neotropics, limiting our ability to generalize to other taxa and regions. Reptiles in particular are understudied and have not yet shown the clear response of other taxa. Here we examine the community and population-level responses of an Afromontane chameleon assemblage to forest fragmentation. We used repeated distance-based sampling in a large forest block and 11 forest fragments in order to quantify the population and community-level responses to habitat fragmentation while accounting for differences in detectability. Chameleon richness decreased with both decreasing fragment size and with increasing isolation. *Rhampholeon temporalis* shows a strong decrease in density with decreasing fragment area, while *Trioceros deremensis*' density decreases only slightly with decreasing fragment area. Neither species was found in the two smallest forest fragments (<3.5 ha), suggesting that each has a similar fragment area threshold. *Kinyongia spp*. show an increase in density as fragment area decreases. Collectively, these results suggest that several small blocks are not equivalent to a single large block. A possible functional cause for this non-equivalency is altered vegetation characteristics in smaller fragments. In some cases the vegetation variables are more strongly correlated with species' density than is fragment area.

Environmental effects on pea aphids and their defensive bacterial symbionts

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Symbioses range from antagonistic to mutualistic and are influenced by environmental factors such as temperature and parasites. Pea aphids, *Acyrthosiphon pisum*, host two facultative defensive bacterial endosymbionts that defend against natural enemies. *Hamiltonella defensa,* when in association with a bacteriophage, defends pea aphids against the parasitoid wasp, *Aphidius ervi,* and the efficacy of this protection is reduced under heat stress. *Regiella insecticola* reduces mortality and sporulation in pea aphids inoculated with the fungal pathogen *Pandora neoaphidis*. Temperature is an important factor in *P. neoaphidis* infection but how temperature affects *R. insecticola* mediated defense against *P. neoaphidis* has not been investigated. To date, studies confirming these relationships have been laboratory based and there is a need to understand how temperature and natural enemies influence symbiont frequency and aphid density in the field. The objective of this study was to correlate parasitism and infection rates with symbiont frequency, natural enemy density, host plant and within canopy temperature. Pea aphids, predators, parasitoids and temperature data were collected in alfalfa and clover fields periodically in southeastern Pennsylvania and the Finger Lakes Region of New York. Pea aphids collected in the field were screened for symbionts or reared in the laboratory to determine symbiont frequency and rates of parasitism and infection. Symbiont frequency, parasitism and infection rates varied seasonally, between locations and between host crops. To date, we have discovered a positive correlation between *H. defensa* frequency, alfalfa and parasitism rate and between *R. insecticola* and clover.

The nesting and neonate ecology of *Pituophis melanoleucus*

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The northern pine snake, *Pituophis melanoleucus*, is a state threatened species native to the New Jersey Pine Barrens. Development and habitat loss have caused the population to decline in recent years. Mitigation of nests in jeopardy may involve translocation to artificial nests, though much of the ecology involving nesting and early life stages of the northern pine snake is unknown. In order to best develop future mitigation efforts, this research will investigate biophysical nesting requirements, neonate emergence behavior, and neonate microhabitat usage. We plan to characterize pine snake nest structure, analyze nest substrate texture, and measure substrate shear strength. Abiotic variables, such as temperature, soil water content, and gas concentrations (O_2/CO_2) will be measured throughout the incubation period until hatching. After emergence, neonate movement patterns will be recorded using a camera monitoring system to elucidate dispersal pathways and potential use of scent trailing. Neonates will be radio-tracked until fall ingress to determine distanced moved from nests, habitat use, and hibernacula site selection. These data will be important for understanding the biophysical requirements of hatchlings and assessing physical constraints on survivorship. Our preliminary season observed four potential nest sites, two of which produced a total of 28 hatchlings, emerging in September 2011. Preliminary video monitoring captured emerging neonates (n=3) dispersing in the same initial direction, though pathways later diverged. A better understanding of nesting and neonate ecology will be important for the conservation of the species and developing mitigation protocols that require translocating pine snake eggs to artificial nest sites.

Establishment year evaluation of the agronomic and invasive potential of fertile *Miscanthus* × *giganteus*

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The 2007 Energy Independence and Security Act mandates increased production of transportation fuel from renewable sources by 2022. *Miscanthus* × *giganteus* has emerged as one of the most promising cellulosic bioenergy crops. Newly developed fertile varieties may reduce establishment costs, but have an unknown impact on the invasive potential, which must be evaluated. In our effort to evaluate the invasive potential of seeded *M.* × *giganteus* in the Southeast, we chose to compare it against ten grass species, comprising 22 cultivars, in four environments in a head-to-head comparison of species introduced for agronomic purposes that are known invasives in the US (positive controls), as well as species that are known not to be invasive (negative controls). After one year of weed-free conditions, fertile *M.* × giganteus densities were lower than both positive and negative controls. However, *M.* × *giganteus* produced 391% and 138% more culms, and had 288% and 102% greater basal diameter than non-weedy and weedy controls, respectively. Established densities of the fertile and sterile *M.* × giganteus cultivars did not differ, but the fertile *M.* × *giganteus* were 57% taller and had 23% more stems than sterile *M.* × *giganteus* 'Illinois'. Stand establishment and growth rates were far lower than johnsongrass (a known invasive species) but much greater than big bluestem (a negative control), suggesting that seeded *M.* × *giganteus* does not present exceptional establishment year spread potential under our conditions. Knowledge gained from these data may help prepare for widespread commercialization, while determining methods for improved stewardship.

Topographic influences on the distribution of white pine blister rust in *Pinus albicaulis* treeline communities, Montana, U.S.A.

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The invasive pathogen *Cronartium ribicola*, which causes white pine blister rust, is contributing to the decline of the keystone species whitebark pine (*Pinus albicaulis*), including those in krummholz treeline communities. Our goals were to determine 1) any spatial variation of blister rust infection in *P. albicaulis* treeline communities near the southern-end and mid-latitudes of the pine's Rocky Mountain distribution, 2) which microtopographic variables correlate with blister rust incidence/intensity among sampled trees, and 3) whether correlates vary between treeline study areas. We surveyed *P. albicaulis* tree/tree islands for blister rust, and assessed topographic influences on disease presence/intensity within alpine treeline communities situated in Glacier National Park (GNP), and the Beartooth Plateau (BP) east of the Rocky Mountain Continental Divide. For each of 60 sampling plots, we created high resolution GPS microtopography surveys, generated GIS-derived terrain variables, and compared these DEM variables with tree disease characteristics in order to determine spatial correlates of blister rust. A slightly higher incidence of blister rust was found among *P. albicaulis* trees in the Divide Mountain (GNP) study area (24%, n=585 trees), compared with the Line Creek RNA (BP) study area (19%, n=328 trees). Tree island *P. albicaulis* had higher infection percentages than solitary trees. Using Bayesian analysis and a zero-inflated Poisson regression model, we determined that solar radiation and moisture variables correlate with the presence/intensity of blister rust cankers on *P. albicaulis*. Local site factors that influence moisture, such as local topography, hydrology, and climate, differ between treelines—which may account for the model variability.

Interactions between fungi and the Ni-hyperaccumulator, *Alyssum murale*

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Alyssum murale Waldst and Kit. (Brassicaceae) is a Ni-hyperaccumulator that originated on serpentine soils in the Mediterranean region. Serpentine soils present many challenges for plants including high levels of toxic metals (Ni, Cr), a low Ca/Mg ratio, and low soil fertility. We explored the possibility that soil nickel concentration influences resistance to fungal pathogens. *A. murale* plants grown in 100 ppm Ni and 500 ppm Ni were inoculated with fungal material, and resistance to infection was measured by comparing initial and final plant size. Plants exposed to fungal inoculum had significantly less biomass remaining at the end of the experiment ($p=0.04$), but pathogen resistance did not differ between the two Ni levels. Further experiments will investigate fungal resistance across a wider gradient of Ni concentrations (0 ppm – 2000 ppm). Since *A. murale* grows on soils with and without nickel in its native range, differences in pathogen resistance may influence establishment and maintenance of populations. We also examined the effects of mycorrhizae on seedling growth in *A. murale.* Plants in soil without Ni showed less growth in the presence of mycorrhizae ($p = 0.\ 0.01$). Plants in soil with Ni at all levels (100, 500, 2000 ppm) showed no significant response to mycorrhizae. Negative effects of mycorrhizal associations can occur if plants are supplying energy to the fungus without gaining substantial benefit. Further studies are underway to stain and observe fungal colonization of *A. murale* roots, and to provide a more complete assessment of seedling growth patterns under these experimental conditions.

Old World nectar and fruit bats: A comparison of obligate and facultative pollinators to examine fitness implications for both plants and pollinators

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Many plant species rely on animals for pollination, thus, pollinator behaviors influence plant fitness. Concurrently, host plants offer nectar rewards that influence pollinator behavior, as natural selection favors the most capable foragers. My research explores both sides of the plant-pollinator mutualism by examining bat species of the family Pteropodidae and their host plants. The family consists of nectar bats (exclusively consume nectar and pollen) and fruit bats (primarily eat fruit but opportunistically consume floral resources). I netted 417 nectar and fruit bats across four sites in Thailand and quantified the pollen species and abundances carried by each to measure potential pollinator impact on plant fitness. I also analyzed time and location of bat captures to compare temporal and spatial differences in foraging behavior. Nectar bats carry significantly more pollen than fruit bats (Kruskal-Wallis, $p<0.001$), supporting my prediction that nectar bats confer greater potential reproductive success to their host plants than do fruit bats. Furthermore, nectar bats visit flowers significantly earlier in the night than fruit bats (Kolmogorov-Smirnov, $p<0.001$), and nectar and fruit bat presence varied between habitats. These temporal and spatial differences in foraging behavior are likely explained by relative dependence on plant resources: nectar bats, but not fruit bats, should forage early, before floral resources are depleted. My results demonstrate that plant-pollinator mutualisms are reciprocal interactions, with tighter associations producing stronger selective pressures on both plants and pollinators. Studying pollinator-mediated gene flow of plants is increasingly important as habitat degradation and loss transform once-contiguous native landscapes into isolated patches.

Landscape influences over nitrogen dynamics during storms

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There have been a number of previous studies on the effects of landscape influence on stream nitrogen, but most have focused on base flow conditions or were conducted specifically within urbanized or agricultural watersheds. In this study we examined a variety of landscapes in nine watersheds within the Little Tennessee watershed in North Carolina. Traditionally land development occurred in the valleys, but recently people have been moving to the mountains. This mountainside development occurs on steeper slopes, which have previously been forested. By evaluating nitrogen dynamics during storms, our study investigated the effects of development on different flow paths and flushing mechanisms. We collected weekly grab samples and measured N export during six storms from 2010-2011. Total dissolved nitrogen (TDN), nitrate (NO_3), dissolved organic nitrogen (DON), and ammonium (NH_4) concentrations were compared among sites. Seasonal trends were seen along with variable DON and first flushing effects within some watersheds. The winter storm was distinctly different than the two fall storms, showing less DON and more NO_3 variability. The weekly grab samples showed variability in DON ranging from 15% - 48% of TDN among watersheds. NH_4 remained low (<11%) of TDN for all sites, while the most forested site showed lowest NO_3 (42%) of TDN and a seasonal trend while the most urban site showed highest NO_3 (78%) of TDN with no seasonal trend. For the storm samples, a two-factor ANOVA across the nine sites showed significant differences with the most and least forested watersheds having the greatest differences.

Five years of stream restoration monitoring data demonstrate successful conversion of rip rap lined trapezoidal channel to diverse stream and wetland habitat

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The Western Tributary of Church Creek in Annapolis, Maryland was restored to a normal riffle pool sequence meandering channel with connection to floodplain wetlands. The project was performed as mitigation for unavoidable stream impacts associated with culvert crossings of headwater tributaries for the construction of extension of Admiral Cochrane Drive to Maryland Route 2 in Annapolis. The tributary had been disturbed previously by channelization, straightening and the placement of rip rap along its entire length. A natural channel design approach was implemented to restore a natural meander pattern and stream profile. Log cross vanes and j vanes were used as structure to form the pattern, and the design incorporated a flood plain bench at the elevation of the bank full discharge. Materials disposal costs were reduced by innovatively reusing the rip rap that formerly lined the channel. The rip rap was wrapped in filter fabric to form the supporting footer logs installed across the stream invert elevation to support the log vane structures. Five years of photographic, biological and geomorphic assessment data indicate that the habitat restoration achieved its design objectives. Water quality data indicate pollutant sources in contributing watershed pose challenges to future ecological lift in species diversity.

Non-riparian water dispersal as a mechanism for local dispersal and population expansion of the invasive grass *Microstegium vimineum*

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Microstegium vimineum is a shade tolerant annual C_4 grass which is invasive in the Mid-Atlantic and upper Southeastern US, and has been shown to negatively impact species diversity and composition in native hardwood eastern forests. To date, empirical studies have shown that local dispersal is limited to ~1m yr^{-1}, which is largely driven by gravity dispersal. However, this likely does not fully account for the mechanisms of population-scale dispersal. Though water, both riparian and ephemeral overland flow, has been a speculated mechanism for dispersal of *M. vimineum,* no studies have been conducted to empirically test this hypothesis.
We designed an experiment along the slopes of a Southwest Virginia hardwood forest to see if marked seed would be dispersed downslope by means of non-riparian water dispersal (i.e., ephemeral overland flow resulting from precipitation). We used a novel seed marking technique by coating seed lots in an ultraviolet powder that did not affect buoyancy to aid in recapture of seed, which is difficult at low densities. Labeled seeds were surface sown and initial UV photos were taken to establish an initial location. Subsequent UV photos collected after rain events in a downslope transect showed seed populations moved unidirectionally downslope with a maximum dispersal event of 0.62 m.

Salinity as a benthic macroinvertebrate community organizer in headwater streams of Virginia's Central Appalachian coalfield region

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Recent studies have found that benthic macroinvertebrate communities in streams below Central Appalachian surface coal mines often differ from communities found in streams in non-mined ecosystems. Elevated salinity, as quantified by total dissolved solids (TDS) and/or conductivity, has been suggested as a stressor to aquatic life in Central Appalachian streams influenced by coal mining. Research reported here was conducted to characterize the biotic response to elevated salinity by surveying benthic macroinvertebrate communities in headwater streams within Virginia's Central Appalachian coalfield region, where salinity was elevated, but where non-TDS stressors were minimized. Biological effects were defined using the Virginia Stream Condition Index (VASCI), a family-level multimetric index of benthic macroinvertebrate community structure that is used for Clean Water Act enforcement in Virginia's non-coastal streams. A total of 81 benthic macroinvertebrate samples were collected at test (n = 21) and reference sites (n = 6) during the Spring of 2009 and 2010, and Fall of 2008 and 2009 using a single-habitat (riffle-run) rapid bioassessment approach. Benthic macroinvertebrate taxa were identified to the genus/lowest practicable level. Water samples were collected during biological sampling and were analyzed for TDS, alkalinity/HCO_3^-, dissolved SO_4^{2-}, Cl^-, Ca^{2+}, Mg^{2+}, K^+, Na^+, and all species of dissolved Al, Cu, Fe, Mn, Se, and Zn.Biological effects, as defined by VASCI scores indicating stressed or severely stressed conditions, were observed with increasing probability from 0% at ≤190 mg/L TDS to 100% at ≥1,108 mg/L TDS. The TDS threshold for observed biological effects was 422 mg/L.

Assessing the effect of select pre-planting, environmental and socioeconomic variables on the condition and mortality rates associated with newly planted trees in Washington, D.C.

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Washington D.C. has experienced a substantial decline in tree canopy cover during the latter half of the 20th century. Casey Trees, a local non-profit organization, was established with the purpose of stabilizing D.C.'s urban forest. Over 10,000 trees have been planted; however, little is known about the condition associated with these trees. In order to enhance the sustainability of Casey Trees' planting program, we established baseline rates of tree condition and mortality data for 4,058 trees planted by Casey Trees between 2005 and 2008 and studied the effect of select pre-planting, environmental, and socioeconomic variables on these rates. Mortality was high, with 24-34% of trees not surviving the first few years of growth. A logistic regression model and factor level chi-square tests, used to assess the pre-planting and environmental variables, revealed that 7 of the 8 variables including nursery, planting time, landuse, space type, year, season, and genera had a significant effect on tree condition and mortality. A separate linear regression model was used to evaluate the effect of the socioeconomic variables. A strong correlation was found between tree condition and mortality and six of the seven factors studied. Education level showed the strongest relationship (r=-0.94), while population density showed the weakest but still a moderately strong relationship with the percentage of trees in the dead and poor condition categories (r=-0.59). This study highlights the critical need for a multifaceted solution in managing high rates of new tree mortality and the ultimate sustainability of urban tree-based benefits.

Relationships between crown and bole size for young urban street trees

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Knowledge of size relationships and allometric equations is a valuable tool that can enable professionals to manipulate urban forests to meet desired economic, social, and ecological benefits. However, there remains limited regional data, as well as data that considers young trees and variable site conditions within the urban landscape. The objective of this study is to address these research gaps and examine interactions between age, bole size and crown dimensions of young urban trees in New Haven, Connecticut in order to identify allometric relationships and generate predictive growth equations. This study examines the 12 most common species from a census of the 1474 urban community planted trees (ages 4-16). Polynomial regressions ($\ln(x)=a + b*\ln(y) + c*\ln(y)^2$) were applied to each species to relate diameter at breast height (dbh), age (years since planting), tree dimensions (total height, crown height, crown diameter), and crown volume (m^3). For all twelve species analyzed preliminary regression analyses reveal a statistically significant predicative growth curve. Within each species dbh has the greatest predictive ability of both crown diameter (R^2 >.70) and crown volume (R^2 =.71). Quercus spp has the strongest relationship between dbh and crown volume (R^2 = .93), while Acer spp has the strongest relationship between dbh and crown diameter (R^2 = .94). Ultimately, these relations will better equip urban forest managers to meet the goals and objectives of their organization, as well as, those of the city. Future study should incorporate urban environmental factors to develop site and condition specific predictive curves.

Using fire scars to construct a historic timeline of disturbance in northeastern West Virginia pine forests

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Information about the range of variability in frequency and size of historic fires can inform future management using prescribed burns, but little is known about historic fire regimes in montane pine forests of the central Appalachian Mountains. We hypothesized that fire suppression and exclusion policies would stop fire after the 1930's, but that fires probably burned routinely during the late 1800's during the height of agriculture. We created a pine master chronology using skeleton plots of increment cores of pitch pines (*Pinus rigida*) collected from Short Mountain Wildlife Management Area in northeastern WV in 2009. We used the master chronology to date sections of pitch pine trees containing fire scars that were collected in 2010 from 14 study sites at Short Mountain Wildlife Management Area and two nearby areas: Lost Rive State Park and Nathaniel Mountain Wildlife Management Area. Preliminary analysis showed a peak in the number of fire scars during the late 1880's but fires continued to occur into the mid 20th century after fire suppression and exclusion policies had begun. For example, a fire at Lost River in 1952 scarred at least two different trees. Our fire scar analysis is ongoing, but results will fill knowledge gaps about the historic behavior and influence of fire in montane pine communities in northeastern West Virginia.

The metabolic fate of soil-derived dissolved organic carbon in the high-latitude Kongsfjord system

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As a result of the earth's changing climate, average surface temperatures in the Arctic are increasing at a rate nearly double that of global estimates (Frey and McClelland 2009). This could have profound impacts on the global carbon cycle as it is estimated that up to 50% of soil carbon sequestered from active circulation is in the Arctic Drainage Basin. Organic carbon sources to adjacent waters may derive from permafrost warming and export as well as fine-grained ice-rafted debris (IRD); however, the fate of these carbon sources along the fresh to marine continuum remains ambiguous. Soil samples and ice-rafted debris were collected from multiple locations along the high-latitude Kongsfjord system in Spitsbergen, Svalbard in October 2009. Bulk geochemical parameters (FTIR, % TOC, mineral content) were measured on the soils. Soils were then extracted with waters of varying salinity and the amount and metabolic fate of desorbed organic carbon was measured. Preliminary results suggest that the permafrost soil desorbs more labile carbon than the IRD and differences can be seen in DOC consumption as it moves along through the freshwater-saltwater interface. The IRD revealed a higher carbon content when compared to the other soils; furthermore, the presence of possible sources of labile organic matter suggests this soil may be a greater source of carbon than previously reported. Data collected from these types of studies is key to understanding the impacts climate change will have on the biogeochemical processes of this dynamic system.

Linking ecosystem services to private property owners in urban forestry

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As governments maximizing their environmental stewardship with extensive tree planting and maintenance programs, the next frontier in urban forestry is the cooperation of government with private landowners. New total daily maximum load (TMDL) values in the Chesapeake Bay set strict boundaries on the influx of sediment and runoff pollutants. These pollutants no longer come primarily from agricultural practices in the watershed. Connecting private landowners to understandable values of their tree cover through concise and relatable values is crucial to meeting these targets. This project aims to connect public communication research and the science behind maintaining tree canopy to identify effective outreach strategies in helping constituents work together to both meet TMDL goals and improve communication and understanding of the impact of development and green infrastructure in our community.

Variations in the sensitivity of growth responses to explosives contamination

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Since its heavy use in World War II Royal Demolition Explosive (RDX) has become not only one of the most important explosives currently in use but also a major environmental contaminant. With a widespread distribution the effects of RDX on organisms needs to be properly understood and quantified. The objective of this experiment was to compare growth characteristics of the shrub *Morella cerifera* in soil contaminated with RDX across an age gradient. *Morella cerifera* was chosen because its growth characteristics are well understood. Based on the mobility of the compound and known effects on plant metabolism it was hypothesized that RDX would have a greater impact on plant growth in juveniles. Young individuals were tested for 8 weeks in soil amended with RDX up to 750 mg RDX kg^{-1} dry soil and measured against standard controls in uncontaminated soils. Adults were treated for 8 weeks in soil contaminated with various concentrations up to 1500 mg RDX kg^{-1} dry soil. Leaf drop, necrosis, reduction, curling, and fluorescence were quantified for all plants. Plants above 100 $mgkg^{-1}$ RDX showed leaf deformation after being in the contaminated soil for a week. Significant leaf drop occurred after two weeks, and new foliage was reduced and curled. Results indicate that RDX contamination showed a similar growth response in both juveniles and adults; however, juvenile plants had lower mortality at higher concentrations. Physiological impacts of contamination depend on its relative age, growth characteristics, and the relationship of the organism to its environment.

Integrating stakeholder engagement, scenario analysis, and ecosystem-service mapping for conservation planning

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When used together, stakeholder engagement, scenario analysis, and ecosystem mapping are useful for conservation planning. These tools can expose potential trade-offs associated with resource-use decisions and help inform difficult environmental choices. The Albemarle-Pamlico basin (APB) of Virginia and North Carolina is facing rapid urbanization and species imperilment that require careful planning to meet the diverse needs of its residents. We assembled representatives from 27 groups working in the APB to discuss ecosystem services (ES) and develop future scenarios based on basin-wide expectations and concerns. We familiarized stakeholders with focal ES and scenario analysis, introduced a comprehensive measure of human well-being (HWB), and asked stakeholders to describe plausible futures of the APB. Four scenarios emerged that contrast local versus basin-wide management and societal investment in environmental protection versus conventional economic growth. We then developed narratives that included population and economic growth trends, landscape changes, conservation efforts, and HWB responses between 2012 and 2050. We also translated the scenario narratives into spatially explicit maps reflecting changes to ES capacity, demand on ES, and HWB. We presented these maps of future ES and HWB to stakeholders at second workshop so they could incorporate our findings into their conservation planning.

A human well-being framework to aid in mapping tradeoffs among ecosystem services and stakeholders

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Ecosystem services are measures of ecological value that warrant consideration in conservation and development decisions. However, important tradeoffs and synergies associated with changes in service delivery cannot be represented by economic valuation alone. Instead, we propose a comprehensive measure of human well-being (HWB) with economics as a component. We adapted the Sustainable Livelihoods Framework (SLF), initially developed by the International Fund for Agricultural Development, to map multi-dimensional tradeoffs and synergies associated with plausible future scenarios of environmental management for the Albemarle-Pamlico basin of Virginia and North Carolina. The SLF comprises five capital components -- financial, social, human, physical and natural -- thought to contribute to HWB. We asked representatives of 27 stakeholder groups in the APB to rank individual capital components and potential indicators of each component based on the perceived relative contribution to HWB throughout the APB. We identified potential measures of the highest-ranked indicators, and then created spatially explicit maps of each measure, indicator, and HWB component. Using the weighted SLF framework and the most recent data available (2009-2011), we quantified and mapped HWB by county throughout the APB. These maps represent the first spatial analysis of HWB within the APB and the first maps of the SLF. They illustrate social tradeoffs associated with land/water use decisions and offer a benchmark of current HWB to be compared with projections based on future scenarios of environmental conditions.

Predicting urban tree success: Modeling tree growth in neighborhood-initiated tree plantings

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Urban trees provide a wealth of ecosystem services to city residents. However, tree-planting success in heterogeneous urban environments is not well understood. In rural settings, three types of variables of the social-ecological system (SES) are thought to influence sustainable resource management: attributes of the biophysical resource, community characteristics, and institutional features. This SES framework is similar to the Clark et al. (1997) model of sustainable urban forestry that purports that sustainable urban forests comprise a healthy vegetative resource, supportive community, and adequate management efforts. Given the limited existing empirical analyses of the urban forest ecosystem, our research applies these frameworks to investigate the following question: What are the social-ecological characteristics that predict urban tree success (establishment, growth, and condition) in Indianapolis neighborhoods? Keep Indianapolis Beautiful, Inc., a nonprofit organization, works with neighborhoods to plant trees and develop community-led management plans with the intent that trees are properly planted and cared for, and the benefits of the urban forest are sustained. We have re-inventoried 266 trees planted in 10 tree planting projects from 2006-2008, and combined this biological inventory data with information about neighborhood characteristics and management methods. Preliminary modeling of tree growth reveals that tree dieback, and competition with other trees have a negative impact, while tree size, presence of a root flare and planting in the fall have a positive impact on average annual caliper increase. Expanded research in Indianapolis in 2012 will test model over many more neighborhood tree plantings.

The role of microbial communities on bullfrog skin in host disease resistance

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As part of the larger ongoing loss of biodiversity around the globe, amphibians have experienced declines and extinctions. A primary factor is the skin disease chytridiomycosis, which is caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*). This study's objective was to characterize bullfrog (*Rana catesbeiana*) skin microbiota and its ability to inhibit *Bd* growth. Sixty-four juvenile bullfrogs from a single pond were sampled for skin microbes. Bullfrogs harbored an average of nine culturable, morphologically-distinct bacterial isolates on their skin, with a range from 1-21 isolates/individual. For a subset of 20 of these bullfrogs I sequenced 1400 bp of the 16S rRNA gene for all of the cultured isolates. I was able to assign 131 of the 144 isolates to genus based on >95% similarity to published GenBank sequences. Isolates from 48 genera were identified, but 28 of these genera were present on only a single frog host. The six most common genera, which were present on between 5-10 frogs, were: *Aquitalea, Chromobacterium, Pseudomonas, Undibacterium, Aeromonas* and *Sphingomonas*. In addition, 11% of cultured isolates had anti-*Bd* properties based on ≥ 90% inhibition in 96 well plate assays. Bullfrogs clearly have a well-developed skin microbiota, and some members of this community might play an active role in disease resistance.

Riparian vegetation abundance changes after dam removal with a focus on invasive species

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Dams only have a finite lifetime, and many must eventually be removed. Removal can change riparian areas in many ways, for example, pond levels can recede and soil can be uncovered. Two dams were removed in New Kent County, Virginia on a tributary of the Pamunkey River. Invasive species can thrive in this area because of the amount of nutrient rich soil which has been uncovered. After dam removal, species were planted in the area to help counteract the growth of invasive species. Percent cover of species present was collected before and after dam removal. These data were collected along 6 transects throughout the pond area. One m^2 quadrats were place every 5 m on each transect. Several Virginia invasive species, *Microstegium vimineum* and *Murdannia Keisak*, were found in the area prior to dam removal. Prior to dam removal, *M. vimineum* had an average percent cover of 17.2%, and *M. Keisak* had an average percent cover of 11.5%. After dam removal, the average percent cover of *M. vimineum* was 7.9%, and *M. Keisak* had an average of 6.2%. Furthermore, after dam removal the average percent cover of planted species was 3.8%. The percent cover of invasive species has decreased since dam removal. However, the invasive species have a higher average percent cover than the planted species.

Investigating golf course landscapes as viable bat habitat

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Bats in Northeastern United States are key components of an ecosystem, serving as biological pest controls and ecosystem health indicators. Habitat destruction combined with the devastating effects of white-nose syndrome and turbine mortality pose a significant threat to bat populations. With continuing land development, new approaches to habitat conservation must be considered. Usually regarded as an environmental problem, golf courses may offer an innovative opportunity of using developed land in conjunction with conservation goals by using natural or man-made features on the altered landscape as possible wildlife habitat. Hard edges and water-hazards on golf courses may encourage foraging bats, and forested patches may offer suitable roosting habitat. Acting as pest predators, bats should be considered beneficial by golf course managers. Using ultrasonic detectors placed at five different microhabitat locations at golf courses across the Delmarva region, I analyzed bat activity and habitat use. Mist netting at the golf courses provided physical confirmation of species present. Preliminary results from acoustic monitoring indicate the presence of seven species in the study region. Most activity occurs near water-hazards and in areas with maintained lawn and high canopy. Open grass areas, dense unmaintained forest patches, and open unmaintained forest patches showed no significant difference in activity levels. The implications of my study can be used in making more informed decisions in designing new and managing existing golf course landscapes that are both beneficial to the game of golf and to bat populations.

Vegetation-desert dynamics in the southern boundary region of Tengger desert, northwestern China

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Extensive revegetation programs in desertified areas in northwestern China began in the 1950s to restrain ecological degradation. Planting of sand-fixing vegetation and rapid socio-economic development has caused changes in land cover patterns. Understanding these changes could assist with prediction of future changes, assessment of sand dune stabilization in preventing spreading deserts, and vegetation restoration policy decisions. We investigated temporal and spatial changes in landcover pattern over past two decades in southern boundary of Tengger desert, northwestern China. Zhongwei city and Shapotou Natural Reserve (SpNR) (~37.51N, 105.18E) provided case studies. We used GeoEye and Landsat sequential imagery for the supervised classification of landcover types and the change detection. We classified land cover into 8 types and grouped into 2 categories (vegetated and non-vegetated)(V/NV), and examined variation of the Normalized Difference Vegetation Index and changes in land cover patterns from 1993 to 2010. Results show that in SpNR, where long-term vegetation restoration has been applied, vegetated area has largely increased. The desert coverage shrank 10.2%, but still dominates among land covers. The ratio of V/NV remains virtually the same in Zhongwei city, but the structure of land covers within the vegetated area dramatically changed. In both sites, woodland coverage sharply increased indicating conversion of farmland into woodland–a result of the "Grain for Green" governmental policy. Overall, desertified areas have expanded at the cost of non-vegetated area such as water bodies and bareland. Vegetation restoration is remarkable in both the natural reserve and at the urban periphery, but even so desertification has intensified at the broad scale.

Population estimate of the northern pinesnake, *Pituophis melanoleucus*, in New Jersey

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Understanding population dynamics is paramount for successful management and long-term conservation of rare species. The northern pine snake, *Pituophis melanoleucus*, is a state-threatened species that is declining in New Jersey. Unfortunately, quantitative population data is lacking and the northern pine snake remains vulnerable as a result of potential delisting, habitat loss, habitat fragmentation, and isolation. We developed a population "density model" for estimating the number of pine snakes at the Warren Grove Gunnery Range (WGR). The model estimates the number of snakes per-unit-area (density) within preferred northern pine snake habitat (pine-oak forest). Utilizing local and habitat specific population densities we estimated an average of 229 adult snakes occur in the local population on WGR. These data were extrapolated to estimate the historic, current, and rate of decline of the northern pine snake population in New Jersey. We estimated that the northern pine snake has experienced declines from as much as 26,087 snakes in 1985 to 24,048 snakes in 2007, a decline of 98 adult northern pine snakes per year. Understanding population size and trends is imperative for improved conservation management of this threatened species.

Plant communities along shorelines in the Chesapeake Bay are altered by both Native American and modern land use history

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Understanding human impacts on ecosystems and plant communities of eastern North America has long been a focus of research. However, we know relatively little about how ancient land-use strategies (e.g., deposition of archaeological food refuse that may enrich soil nutrients) may influence the present day composition of plant communities. We examined plant community structure and composition, including the abundance of invasive species, at paired archaeological shell midden and non-midden ("control") sites dated from 3000-150 years ago along shorelines of the Upper Chesapeake Bay, Maryland. We also measured important aspects of soil chemistry that could influence plant communities. In contrast to other published studies, we did not find increased abundance of invasive plants on middens, although middens were dominated by forbs and grasses and had fewer trees than off-midden sites. Similarly, midden soils had significantly higher concentrations of calcium, nitrate, phosphorous, and potassium than off-midden sites, consistent with other published studies. Our results could inform preservation and conservation goals on lands that have been impacted in pre-colonial times.

Effects of parental origin on seed production and germination in controlled crosses of *Vallisneria americana*: implications for stock selection in restoration of submersed aquatic vegetation

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Selection of seed stock for restoration initiatives remains a complex issue. Sourcing restoration stock as locally as possible reduces the chances of genetic dilution by maladapted genes or outbreeding depression, whereas mixing disparate sources of stock may increase diversity and counteract inbreeding depression. However, understanding of the scales at which each of these risks are most prevalent is lacking, yet this information could make restoration efforts more effective by increasing the restored population's chance of persistence. We evaluated seed production and germination success of seeds produced from controlled reproductive crosses of the submersed aquatic plant *Vallisneria americana* (wild celery) collected from populations throughout the Chesapeake Bay. Specifically, we assessed differences in seed traits, capsule traits, and germination success in crosses from individuals within-populations, among-populations but within-genetically differentiated regions, and among-regions. We found that there are differences in seed and capsule production within-populations as well as in crosses that occurred among-regions. However, among-population crosses within genetically defined regions were not different from within-population crosses. We further explore how reproductive success can be maximized in restoration efforts by considering levels of genetic relatedness among individuals, genetic diversity within populations, and differentiation across populations.

Evidence for associative nitrogen fixation in feedstock grasses

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Rising demands for renewable energy have led to the increase in production of feedstock grasses. These perennial grasses can yield large quantities of lignocellulose useful for the production of biofuels. Such grasses include *Miscanthus xginganteus* (*Mxg*), *Pancium virgatum* (switchgrass), *Saccharum officinarum* (sugarcane), and energycane (US 02-147). Associative nitrogen fixing bacteria often colonize the roots and rhizospheres of grasses and may help these grasses meet nitrogen needs. However, it is not known if all feedstock grasses are colonized by diazotrophs and whether these bacteria can help meet grass nitrogen demand. The objective of this study was to identify whether nitrogen-fixing bacteria are associated with these energy grasses and also to assess the potential for nitrogen fixation in these energy grasses. Changes in the natural abundance of $\delta^{15}N$ are being assessed over several years as a proxy for plant and soil diazotroph derived nitrogen accumulation. Field studies thus far indicate that the natural abundance of $\delta^{15}N$ varies over two growing seasons. In particular the roots of energycane grass show a significant decrease in $\delta^{15}N$, and high biomass yield, indicating the potential for accumulation of recently fixed N_2. Moreover diazotrophic microbial communities were identified in rhizosphere and inside roots to support for the variation in $\delta^{15}N$. Further results are needed to verify these relationships.

The extirpation of the Ridgway's Hawk *(Buteo ridgwayi)* from three Haitian satellite islands

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Ridgway's Hawk's *(Buteo ridgwayi)* is endemic to mainland Hispaniola and the Haitian satellite islands, but is believed to have gone extinct from Haiti in recent decades. It seems likely that deforestation and land cover change have degraded the hawk's habitat; however, land cover change in relation to *B. ridgwayi's* existence remains unstudied. *A main objective of this research is to document land cover changes on three Haitian satellite islands from 1990–2010 through the analysis of Landsat 5 TM satellite imagery to assess impacts on hawk populations. The s*tudy sites, the islands of Grande Cayamite (10 km²), Ile-a-Vache (6 km²), and Ile de la Gonave (20 km²), have preferred hawk habitat and are locations of previous *B. ridgwayi* specimen collections. Preliminary data indicate the effects of abundant karst topography compounded with intense seasonality of precipitation delimit late January as the optimal time of year to collect satellite imagery. We implemented *supervised and unsupervised classification methods during the image processing and a* 30-cm resolution 2010 aerial photograph was cross-referenced. *The final classified images contain four informational classes: Agriculture, Forest/Dense Vegetation, Barren/Eroded, and Urban/Road*. Accuracy assessments based on GPS coordinates collected during upcoming field work will determine whether to use the supervised or unsupervised image in the final land cover change calculations. We will employ surveys to document local people's perceptions of *B. ridgwayi* in order to better understand the anthropogenic factors involved in the extirpation of the hawk.

Preliminary evaluation of gastric lavage as a technique for sampling diets of bonefish (*Albula vulpes*) in Eleuthera, The Bahamas

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Bonefish (*Albula vulpes*) inhabit shallow tropical and subtropical flats environments throughout The Bahamas and are prized as a sport fish. It was recently estimated that flats fishing contributes $141 million annually to the Bahamian economy. Ecologically, as adult bonefish move between various flats habitats and forage in the benthos, they play a role in shaping the physical structure of the flats substrate and may serve as conduits for nutrient cycling.

Understanding bonefish diet and feeding ecology is critical to assessing the implications of development related habitat destruction on the population ecology of bonefish. However, data on food habits of bonefish in the Bahamas are limited. Typically, studies of fish diets have been accomplished by collecting and sacrificing fish to excise their stomach or digestive tract and inspect gut contents. However, the use of gastric lavage has recently proven to be effective as a nonlethal technique for performing diet analysis on a number of species of fishes. This technique uses pulses of water to flush the stomach contents from the fish.

Our preliminary evaluation in 2011 was a proof of concept project to see if gastric lavage would be an effective method for collecting stomach contents of bonefish. In 2012, an experiment designed to evaluate post-lavage mortality was conducted to determine if stress-induced mortality would result from using this technique. The outcomes of both of these efforts are being used to develop a more detailed study of feeding ecology of bonefish on the flats of The Bahamas using this technique.

Small mammal abundance and distribution on military training lands on Fort Pickett Maneuver Training Center, Blackstone, Virginia

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Military training installations often implement land-use management decisions by manipulating the composition and density of vegetation cover types in order to create terrain conditions best-suited to support their specific training objectives. Areas with different vegetation cover types are used for different types of training, and so are subjected to different types and intensities of training disturbances. We used a combination of box traps and pitfall traps to investigate species composition, diversity, distribution, abundance and seasonal variation of small mammal populations in 3 different vegetation cover types and corresponding disturbance categories on Fort Pickett. We captured 459 individuals representing 12 species over 6700 trap nights. Species diversity was lowest overall in the grassland areas that are open to a greater range of training and related disturbance than in forested areas. Seasonal diversity declined in both forested and non-forested areas from summer to fall, but while seasonal relative abundance also declined in the forested areas, it increased in the non-forested grasslands over the same period. Diversity and relative abundance was lowest overall across all habitat types in plots within dedicated impact areas where fires are frequent as the result of live rounds and artillery fire.

Preliminary examination of the indirect and direct effects of white-tailed deer (*Odocoileus virginiana*) on native and invasive plant species

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Exotic invasive species cause great ecological and economic costs. Several hypotheses have been formulated to explain the success of invading plants, including the novel weapons, enemy release and EICA hypotheses. Overabundance of herbivores can compound the success of exotics through both direct and indirect effects. An experiment has been set up to test for direct (e.g., selective browsing) and indirect effects (e.g., soil compaction) of deer on native and invasive plants using paired exclosure and control plots in forest fragments at Blandy Experimental Farm, in the Shenandoah Valley of northwestern Virginia. To test for direct effects, monthly surveys were performed within each exclosure and control plot through the 2011 summer growing season, as well as comparisons of herbivore damage to planted trees during winter 2011-2012. Baselines for indirect effects were also established through soil nutrient analyses, soil compaction and bulk density tests, and light intensity measurements. After one sampling season, a similarity analysis between plot pairs indicated moderate to high similarity in species composition between each pair. Analysis of herbivore damage indicated deer showed little preference between planted tree species. With regard to indirect effects, there was no difference between exclosures and controls for all soil nutrients and compaction measurements except for surface compaction which, along with light levels, was significantly lower in exclosures than controls. Effects will be monitored throughout the remainder of this project, with these preliminary results providing a framework for further analyses on the direct and indirect effects of white-tailed deer.

Quantifying *Metagonimoides oregonensis* infection in stream salamanders

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Relatively little is known about transmission dynamics for most wildlife helminths, including trematodes. The life cycles of trematodes are complex, typically involving three hosts. Understanding transmission dynamics in natural systems is difficult due to the variation in landscape use and response to environmental conditions. Trematodes are common in freshwater streams, as snails are obligate first intermediate hosts. *Metagonimoides oregonensis* in the southeastern U.S. uses stream-dwelling *Pleurocera proxima* snails as a first intermediate host, stream salamanders as a second intermediate host, with metacercariae encysting in the muscle tissue, and raccoons as a definitive host. To understand the role of various stream salamander species as important hosts, we examined 289 salamanders collected from 23 sites in North Carolina in 2009. All salamanders were cleared and stained and their abdomens were examined for the presence of *Metagonimoides oregonensis* metacercariae. Six plethodontid salamander species were represented in the samples, including *Desmognathus quadramaculatus* (n=69), *Eurycea wilderae* (n=160), *Desmognathus ocoee* (n=31), *Desmognathus monticola* (n=3), *Eurycea guttolineata* (n=7), and *Gyrinophilus porphyriticus* (n=19). There were clear patterns of varying prevalence and intensity of infection among the species. *Desmognathus quadramaculatus* had higher prevalence and intensity of infection than any of the other species. This pattern was not linked to body size, as there was no correlation between body size and intensity of infection among the species. This indicates that susceptibility to the parasite may vary by individual species.

The persistence of soil microbes: active community composition and capability to respond to litter addition after ten years of no-inputs

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It has been speculated that the high microbial diversity found in soils may be due in part to a large inactive-biomass that is able to persist in soils for long periods of time. This persistent microbial fraction may help to buffer the functionality of the soil community during times of low nutrients by providing a reservoir of specialized functions that can be re-activated when conditions improve. A study was designed to test the hypothesis: Following 10-years of no above- or below- ground inputs from plants, new inputs will stimulate the growth and activity of a persistent microbial community able to break down litter and having a community composition similar to control soils. Soils from the HJ Andrews Experimental Forest's Detrital Input and Removal Treatments (DIRT), the No-Input plots and Control plots, were used in a microcosm experiment where Douglas-fir needles were added to soils. After 3 and 151 days of incubation, soil microbial rDNA and rRNA was extracted and characterized using Q-PCR and 454-pyrosequencing. At Day 3, 16S rRNA gene copy numbers were significantly higher in Douglas-fir amended soils, but the control and no input soils did not differ. Analysis of ~108,000 bacterial sequences showed a significant change in the active (RNA-based) community between Day 3 and Day 151 but microbial composition was similar between soil types. These results show that even after 10 years of plant litter exclusion, the legacy of community composition was well buffered against a dramatic disturbance.

Carbon Stocks in Urban Forest Remnants: Atlanta and Baltimore as Case Studies

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Urban environments influence carbon (C) and nitrogen (N) cycles of forest ecosystems by altering plant biomass, litter mass and chemistry, passive and active pools of C and N, and the occurrence and activity of decomposer organisms. It is difficult to determine the net effect of C storage due to the number of environmental factors exerting stress on urban forests. Using a conceptual model to synthesize results from gradient studies of forest patches in metropolitan areas, we attempt to explain the mechanisms affecting C cycling. We also assess the relative importance of C accumulation in urban remnant forests with respect to other land uses previously disturbed or managed. The cities of Baltimore and Atlanta are used as case studies. The C density of forest above-ground biomass for Baltimore City, 8 kg m^{-3}, and Atlanta, 10.6 kg m^{-3}, is significantly higher for both medium- and high-density residential areas. Baltimore City has a forest-soil C density of 10.6 kg m^{-3}, a below-to-above ground ratio of 1.3. Urban forest remnants in these two cities store a high amount of C on a per-unit basis both above- and below ground relative to other land uses, but total C storage is lower due to the lower acreage of urban forest in these cities relative to other land uses.

Measurement of invasive plant cover changes to prioritize and assess exotic plant control efforts in a rare Virginia wetland

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Documenting changes in exotic and native plant populations and the effectiveness of are an essential component of assessment of resource management efforts. Shenandoah National Park is home to Big Meadows Swamp (BMS), a globally rare Blue Ridge Mafic Fen. Monitoring performed over a five year period focused on 13 target plant species, including four invasive exotic plant species and eight species of state rare native plants. This study sought to estimate the changes in cover of the target species, identify priority areas for exotic control, and assess the effect of current control measures. Sampling was conducted in 2006, 2008, and 2011 at 978 points on a 10 x 10 meter grid in BMS. At each point, percent cover was estimated for each target species in a 1 x 1 meter quadrat. In two areas of greater rare plant abundance hand-pulling as a means of control for three target exotic species was conducted after the 2006 sampling. After the 2008 sampling, limited herbicide spraying was also began in these areas. Preliminary analyses indicate that among exotic plants, *Microstegium vimineum* cover increased significantly only outside of controlled areas while *Polygonum caespitosum* exhibited a significant decline only in controlled areas. *Alliaria petiolata* exhibited a significant decline throughout the study area. The results suggest that present control methods are effectively halting the spread *of P. caespitosum* and may be preventing significant increases in *M. vimineum* within controlled areas. The decline of *A. petiolata* throughout the study site cannot be explained by control efforts.

An improved decision support system for managing red-cockaded woodpecker populations: Incorporating landscape disturbance into population models

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As one of the largest landowners in the United States, the Dept of Defense (DOD) has the unique challenge of balancing training needs related to national security with conservation laws mandated through the Endangered Species Act. The red-cockaded woodpecker (RCW) is one of many federally endangered species with significant populations on DOD land, primarily in longleaf pine ecosystems on military installations throughout the southeast. A population model, the RCW Decision Support System (DSS), has already been developed to help DOD personnel identify and prioritize habitat parcels on and in the vicinity of DOD installations. This model is spatially explicit and able to incorporate the complex social and dispersal behaviors of the species in addition to standard fecundity and mortality rates. However, it does not consider the dynamic nature of the fire-dependent longleaf pine ecosystem. The objective of our applied research is to create a more realistic model of the interplay of RCW population dynamics with the constantly evolving condition of the species' habitat. Here, we will outline our landscape model of habitat dynamics, developed in the state and transition model PATH, and discuss how we will combine the separate population and landscape models in a meta-model approach to aid in the management of RCW populations and their habitat. Our research provides a unique framework for considering both the habitat and the species in models used to inform conservation management.

The distribution and prevalence of *Metagonimoides oregonensis* (Trematoda: Heterophyidae) in southwestern Virginia and northwestern North Carolina

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Most human emerging infectious diseases originate in wildlife, but we know little about the ecological mechanisms that regulate host-pathogen interactions in wildlife systems. Digenetic trematodes are parasitic flatworms with complex multi-host life cycles; they cause numerous human diseases (e.g. schistosomiasis) and can have significant negative impacts on wildlife. Identifying the factors that are important in trematode-host interactions can advance our understanding of the dynamics of infectious disease. *Metagonimoides oregonensis* is a North American trematode that infects raccoons as definitive hosts, and stream snails (*Pleurocera* spp.) and amphibians as intermediate hosts. Other than the basic life-cycle, we know little else about this parasite. During the summer of 2011, we surveyed snails from 26 streams to examine the distribution and prevalence of *M. oregonensis* in southwestern Virginia and northwestern North Carolina and to identify ecological and environmental factors that are important in infection dynamics. With the exception of one stream, *M. oregonensis* was present at all sites, ranging in prevalence from 1-20% of snails infected. In addition to *M. oregonensis*, we found at least four other families of trematodes. These trematodes are parasites of aquatic insects, fish and birds, and with up to 38% prevalence, were more prevalent at some sites than *M. oregonensis*. There is increasing evidence that community diversity is a key factor in disease dynamics, and future research within the *M. oregonensis* system will focus on how stream community composition of both parasites and hosts may impact trematode infection rates.

Young forest composition and growth on an Appalachian coal surface mine

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A 29-ha mine site in Buchanan County, Virginia, was reclaimed using methods intended to produce favorable soil conditions and planted with forest trees in early 2002. After soil grading, the site was mapped for forest site quality considering rock type, aspect, and soil compaction. Trees of eleven species and one shrub species were prescribed for planting as four species mixes, each targeted for specific growing conditions. In 2010, 68 measurement plots were established over the site on a gridded pattern. Within each, soils were characterized and living trees and shrubs were measured for breast-height diameter and height. Data were analyzed to assess density and volume, overall and by species, and to evaluate how these metrics responded to soil and site conditions. After 9 growing seasons, 24 tree and 3 shrub species were recorded as growing on the site; most living trees were of non-planted native species. Prominent volunteers were *Robinia pseudoacacia*, *Oxydendrum arboretum,* and *Betula lenta*; prominent planted species were *Fraxinus sp., Quercus alba*, and *Platanus occidentalis*. Volunteers established and grew best on more acidic soils, on sloped areas where soils were not compacted, and on areas rated as having higher forest site qualities. Community composition and volume also varied with these site features. Planted trees' species composition varied with planting mix and site conditions. On non-compacted soil areas, planted trees' overall density and volume metrics exhibited few differences that were directly related to site conditions, in part because species selected for and planted preferentially on areas with conditions poorly suited for most native trees were able to establish and grow.

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