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**Enemy release and evolved increased competitive ability in *Spartina alterniflora* invading Pacific U.S. estuaries**

*Spartina alterniflora*, an Atlantic and Gulf coast native halophyte, was introduced to the Pacific U.S. coast over the last century. Historical biogeographic differences in the range of its specialist herbivore, *Prokelisia marginata*, allow testing of two prominent hypotheses used to explain invasive plant success: enemy release and evolved increased competitive ability. A three-way factorial experiment utilizing greenhouse mesocosms was conducted in 2006 with source population, *P. marginata* presence/absence, and nitrogen fertilization (high/low) as fixed factors. Five *S. alterniflora* populations were included, with at least one representative from each possible herbivore history (native, invasive but never separated from *P. marginata*, invasive and separated). Changes in nitrogen supply rates (obtained with Plant Root Simulator probes) and plant performance (plant size and reproductive traits) were measured. Comparisons among *S. alterniflora* populations suggest that plants from invasive populations tend to be larger ( $F=3.66$ ,  $P=0.0082$ ) and more fecund ( $F=13.74$ ,  $P<0.0001$ ), but are equally tolerant ( $F=1.94$ ,  $P=0.1666$ ) and resistant ( $F=1.22$ ,  $P=0.3080$ ) to herbivory. Total nitrogen and nitrate supply rates were similar for native and invasive populations, suggesting comparable nitrogen uptake rates, but populations varied in their responses to the combined effects of fertilization and herbivory ( $F=3.41$ ,  $P=0.0106$  and  $F=2.79$ ,  $P=0.0288$ , respectively). These results imply that rapid evolution for larger, more fecund plants with slightly increased nitrogen utilization may have occurred in invasive populations, but that herbivory is not the sole driver. A second experiment, comprised of competitive plantings between populations with and without herbivores, will provide a link between predicted and actual competitive ability.

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**A unique approach to stream and wetland restoration using shallow pools, cobble weirs, and sand seepage features**

The creation of Atlantic white cedar (AWC) wetlands using a combination of pools, cobble weirs and sand berms results in a system of physical features, chemical processes, and biological mechanisms that can have dramatic effects on the hydrology of the project site, including water quality benefits. The physical

modifications necessary to establish the sand seepage hydrology most suitable for the establishment of the AWC wetlands, result in the creation of a series of well vegetated stilling pools, sand seepage beds replete with above and below-ground biomass, and associated flow paths through low areas dominated by peat forming Sphagnum. The physical effect of the pools and their many plant stems is to reduce water velocity and facilitate removal of suspended particles and their associated nutrients and/or contaminants. Uptake of dissolved nutrients and adsorption of oils and greases by the many plant stems present in the pools yields additional benefits. The cobble weirs set the surface water elevations and establish the head necessary to drive the sand seepage dynamic that supports so many bog species, including the AWC. In addition, the sand seepage bed supports microbial populations and processes which remove nutrients and contaminants which pass through the sand bed. Furthermore, the many roots present in the sand take up nutrients and provide sites for microbial attachment, contaminant adsorption, and long-term sequestration in the peat forming in this layer as a result of AWC annual root formation. Similarly, water flowing through the lower areas dominated by peat forming Sphagnum are subject to many of the same physical and chemical processes. Field data on sand seepage wetlands combined with literature reports on water quality treatment practices will be used to document the value of AWC sand seepage wetlands for watershed restoration.

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**Smut fungus infection in the perennial grass *Andropogon virginicus* (broomsedge): Individual and population level consequences**

Pathogens have important effects on individual plants and their populations, but have not been well studied. We investigated a plant-pathogen system in which the perennial old-field grass *Andropogon virginicus* (broomsedge) is attacked by the parasitic smut fungus *Sporisorium ellisii*. This smut replaces its host plant's reproductive structures with its own teliospores. In a three-year field study conducted in New Jersey from 2004-2006, we investigated the relationship between host population density and disease frequency by counting infected and healthy plants within 480 permanent 1 m<sup>2</sup> plots each year. The effect of disease upon individual plants was measured on focal plants. Data from a 2002 pilot study of 192 plots provided a population baseline, with mean plant density 5.47 / m<sup>2</sup> and, on average, 29.8% plants infected per plot. By 2006 mean density had decreased to 3.26 and mean disease to 5.9%. Higher disease rates were correlated with lower plant density in plots where disease was present, suggesting that smut fungus infection has a negative effect on the broomsedge population. Fully infected plants were smaller than healthy plants, were at significantly higher risk for mortality, and produced no seeds. Although 21.2% of infected individuals recovered from disease, 70% of infected plants died after two years compared to 43% mortality in healthy plants. Therefore *S. ellisii* has a negative effect

upon *A. virginicus* and may act both in population regulation and, potentially, as an agent of natural selection that drives the evolution of *A. virginicus* populations towards increased resistance.

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**Can ecology inform security? A metapopulation analysis of the insurgency in Iraq**

Metapopulation theory has greatly increased our understanding of spatially structured populations and is widely applied in conservation efforts. But can a metapopulation perspective prove informative for a population that is not strictly ecological? I used a metapopulation approach to analyze the insurgency in Iraq. This approach examined the dynamics of extinction and colonization of local insurgent populations, allowing for the development of simple metrics of insurgent activity that are informative to strategy. The size of the insurgent metapopulation (i.e., number of occupied sites) is significantly increasing over time, from a low of four in May 2003 to a high of 23 in May 2005 and October 2006, with more than 99 sites occupied at least once. The increase is caused by greater local colonization than extinction. Rates of colonization are dominated by the colonization of virgin sites until January 2004, at which point the return of insurgents to previously occupied sites increases in importance. A successful strategy in controlling the insurgency must address factors that both locally reduce the insurgency and prevent its return. As this insight demonstrates, ecology can be informative to national security. I encourage ecologists to expand the application of ecological principles to fields beyond traditional environmental boundaries.

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**Habituation of male *Arrenurus manubriator* (Acari: Hydrachnida) to female sex pheromone**

Male *Arrenurus manubriator* mites were tested to determine whether response to female pheromone decreased with increased duration of exposure. Groups of virgin males were housed with a single virgin female for 1, 24, 48 or 72 hours. Males were exposed to pheromones during this period, but were not allowed direct contact with the female. The males' response was tested in a circular arena divided into an central circle and an outer ring. Groups of 50 males were introduced to the arena, and either 0.6 ml of untreated water (negative control) or female-conditioned water (test groups and positive control) was injected into the center of the dish. Observations over time were used to determine when maximal responses to pheromone occur, and hence the optimal time for comparisons among treatments. Five groups of positive controls

confirmed that sufficient pheromone was present and that males were responsive, and also indicated that the peak response occurred approximately 180 sec. after introducing pheromone to the arena. In trials involving 1 and 24 hr. pre-exposure to pheromone, males responded just as strongly to pheromone as did positive control groups. After 48 and 72 hours of exposure to female pheromone, significantly fewer males responded during observation intervals.

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#### **Stream ecology in Pine Barrens landscapes: Does monitoring improve with taxonomic refinement?**

Macroinvertebrate fauna of woody debris (submerged sticks 3-35 mm in diameter) provides a readily sampled assemblage for biological monitoring in New Jersey Pine Barrens streams. Work from 2003 to 2006 has shown that these assemblages change as encroaching agriculture and urban development raise pH and specific conductance above their typically low values and alter the physical characteristics of the stream and flood plain. Previously, we used order and family level classifications in our multivariate analyses. This presentation reports on whether classifying the Trichoptera in the samples to the generic level enables us to detect more subtle changes in conditions. Trichoptera form a useful group for analysis because the various genera display a wide range of ecological tolerance, and at least 15 genera occur on submerged sticks in our samples. Results on our samples through 2006 fail to support the hypothesis that greater taxonomic refinement allows better discrimination among sites. Determining the genera present in every sample is probably not cost-effective in a large-scale, community based monitoring program.

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#### **Air pollution and invasive species: Threats to the Northeast Atlantic forests**

Intact forests around the world are currently facing a threat, which if remained unchecked will lead to a dramatic dieback of more than half of the current stands. The menace comes in form of both air pollution and invasive species. Unfortunately, very few scientists have concentrated on the interplay between air pollution and invasive species within forest ecosystems. To appraise the reaction of both native and invasive plants to various air conditions, it is essential to determine any gas-exchange systematic differences between these two plant groups. Stomata density and stomatal conductances of common native and invasives found throughout forests along the U.S. east coast supported the hypothesis of increased invasive resistance to

ozone exposure. Forest surveys evaluated the concentration of ozone and presence of invasive species around three cities: Washington, DC; Baltimore, Maryland; and Philadelphia, Pennsylvania. Situating sites at points along an ozone gradient (low 0-60 ppb, medium 80-99 ppb, high 111-125+ ppb) allowed for the assessment of ozone influence. Throughout all three cities, invasive presence and ozone damage was greater in locales exposed to high mixing ratios of ambient ozone. The data collected for this study point to invasives as being more apt in tolerating higher concentrations of ozone. Further studies will be performed to detail the amount of damage incurred and ozone uptake of each plant group when exposed to a regime of ozone exposure.

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#### **A pictorial atlas and identification keys to the scale patterns of guard hairs for all indigenous Pennsylvanian mammalian species**

Mammals are identified based on several features, including morphology (cranial, postcranial, dentition, etc.) and behavior. Although scale patterns of mammalian guard hairs are among distinguishing elements to identify mammals, presently there are no identification keys for patterns of mammal guard hairs in Pennsylvania. Guard hairs for the 74 mammal species were obtained from diverse sources. Each hair sample was cleaned with 70% ethanol. Hair casts were made with corrector fluid and applied on clean 25 x 75 mm glass slides. Then, a high-resolution digital photograph of each cast was taken at 40x magnification. All of the photographs were compiled into a master database and each file was analyzed and grouped based on scale patterns. Then, two types of dichotomous keys were composed. One key would be used for the identification of each family while the other key would be used for the identification of all species present within each mammalian family in Pennsylvania. This pictorial work will comprise six sections; 1- an introduction with background and data collection information; 2- a pictorial glossary of the terms used to describe the patterns; 3- a section describing the making of the keys and how to use them; 4- all dichotomous keys; 5- an annotated section covering each species; and 6- a cross-referenced index. It is our goal that these keys and atlas will provide an easy way to identify the species of mammals in Pennsylvania based on hair remain (scats, stomach content, hair traps, owl pellets, etc.).

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**The effects of the invasive tree, *Ailanthus altissima*, on the biodiversity and biomass of understory plants**

Invasive plant species, such as *Ailanthus altissima*, have been shown to cause many problems to local plant communities, including a decrease in local biodiversity and biomass. Some invasive species may change communities through allelopathy. Lab results show *A. altissima* is allelopathic and the toxin produced by *A. altissima* does decrease the germination and growth of many dicot plants. Our research was designed to extend past laboratory results to the field. Our goal was to determine the impact of *A. altissima* on understory plant biodiversity and biomass. We located four large stands of *A. altissima* in the Fredericksburg area. Six subplots were randomly chosen under the canopy of each *A. altissima* stand and under an adjacent native forest plots. Plant species richness, species stem count, and species percent covers were recorded for each subplot. The species richness of understory plants was not significantly affected by *A. altissima* presence ( $p = 0.613$ ). The abundance of all understory plants was found to be higher under the invasive canopy (stem count,  $p = 0.006$ ; percent cover,  $p = 0.017$ ). Vine abundances were higher under the *A. altissima* (stem count,  $p = 0.021$ ; percent cover,  $p = 0.043$ ). Unexpectedly, the herbaceous dicot abundances were also greater under the invasive canopy (stem count,  $p = <0.001$ ; percent cover,  $p = 0.002$ ). In conclusion, we found that *A. altissima* does not seem to negatively affect the community diversities as expected. To the contrary, some functional groups grew better under the cover of this allelopathic invasive.

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**A modified colorimetric bait-lamina method for estimating litter decomposition by soil microinvertebrates**

Understanding the effects of land-use on soil fertility, soil quality, and nutrient cycling requires detailed knowledge of the structural composition and functional strategies of the microinvertebrates that decompose organic matter within the soil ecosystem. Several methods for assessing litter decomposition by microinvertebrates presently exist: litterbag, litter-container, mini container, and bait-lamina. However, interpretation of results may be complicated by contamination of litter samples with soil and external debris. The bait-lamina test, a plastic-strip with bait-filled holes that is inserted into the soil, was designed for assessments of contamination on soil communities and provides only a qualitative estimate of decomposition. In this study, we introduce a modification to the bait-lamina method that uses a colorimetric assessment of extracted plant protein to minimize bias from adhered soil particles and

provide a quantitative estimate of bait consumption. The protein within the plant litter "baits" is measured by a modified Bio-Rad assay using an ELISA plate reader at 340 nm wavelength. The amount of protein remaining within the bait following incubation in the soil provides an index of litter mass consumption by soil microinvertebrates. This approach to a more exact quantitative measurement of litter consumption in bait-lamina strips should result in an improved and increased understanding of the role microfauna play in soil decomposition.

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**Jack of all trades: Biological invasion facilitated by use of multiple forms of nitrogen**

*Alliaria petiolata*, or garlic mustard, has been successful in invading deciduous forests of the Mid-Atlantic United States since its colonial era introduction from Europe to the United States. Garlic mustard's success as an invasive species can be partially attributed to its ability to efficiently utilize multiple pathways while taking up nitrogen in both of its inorganic forms: nitrate and ammonium. Inorganic nitrogen is known to be one of the most limiting nutrients in northern hemisphere soils. Garlic mustard's utilization of inorganic nitrogen was studied by growing plants hydroponically. Fertilizer solutions varied in total nitrogen concentration (250mM, 1000mM, 2000mM) and ratio of nitrate to ammonium (0:100, 25:75, 50:50, 75:25, 100:0). The pH was standardized across all solutions. Field plants were transplanted to a nutrient free mixture of sand, perlite, and vermiculite and grown in the greenhouse at Rider University for the duration of the experiment. Analyses of photosynthetic rate and physiological measures show that while total N concentration influences plant vigor, the ratio of nitrate to ammonium has no statistically significant effects on plant growth. Garlic mustard's ambidextrous use of available resources is an important part of the success of this invasive species.

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**Colonization of adjoining forest and fallow field plots after extensive hurricane damage**

We compared seedling colonization over three years between a forest damaged by Hurricane Isabel and an adjacent fallow farm field that had been used to raise crops and graze animals for at least 150 years. We examined colonization traits such as seed dispersal, species composition, mortality, and patterns of growth. The study area was in the Piedmont of Maryland. Succession differed dramatically between forest

and field over the first three years of study. Tulip poplar is the dominant species in the field plot, and almost absent in the hurricane damaged forest. The number of seedlings in the plot decreases with distance east of the forest edge, and seedling height also decreases with distance east of the forest. The mortality rate of the exotic tree *Ailanthus altissima* is considerably higher than for native species.

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#### **Long distance movement and hydraulic disruption by *Xylella fastidiosa* in host tree xylem: Passive migration or cellulose degradation and cavitation**

*Xylella fastidiosa* is a vascular pathogen with a wide host range including economically important and naturally-occurring host plants. It is the causal agent for Pierce's Disease and alone threatens the California wine, table and raisin grape industry valued at \$45 billion annually. Currently, there is no way to therapeutically treat *X. fastidiosa*-infected hosts, and the means by which the bacteria move throughout the xylem of host plants is unknown. Approximately 41% of the oak species on Saint Joseph's University campus are infected with *X. fastidiosa* and a map was created to document the extent of the disease in this urban ecosystem. To better understand how the bacteria systemically colonize host xylem and cause leaf scorch symptoms, we studied xylem structure and function in infected and healthy oaks. Using a microcapillary procedure, we found that pit membrane pores of current annual growth were smaller than the bacteria and suggest that the bacteria require a mechanism to degrade the pit membrane barrier to migrate throughout the host xylem. Hydraulic conductivity in petioles of infected trees was lower than that of controls and decreased to zero upon the arrival of "scorch" symptoms. Early in the season the percent embolism of xylem vessels in infected petioles was significantly higher than that of healthy trees, suggesting that the bacteria disrupt pit membranes when colonizing new host xylem. Understanding the exact mechanism of long distance *X. fastidiosa* movement in hosts will allow us to better predict susceptibility of hosts under a range of conditions.

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#### **What is the zone of influence of an individual tree on the soil microbial community structure and function?**

In West Virginia, landscape fragmentation results in areas with gradual blending of forests and pastures ecosystems. Studies that address changes across ecological gradients must take into consideration the zone of influence of each ecosystem to

ensure that samples taken represent maximally each individual ecosystem. A study was conducted to determine the zone of influence of individual black walnut and Chinese chestnut trees (*Juglans nigra* and *Castanea mollissima*, respectively) on soil microbial communities using BILOG and molecular methods. We collected soil samples at 5 distances from the tree trunk (0.25, 0.5, 1, 2, and 4 m) and compared these samples to a nearby pasture area. Our results show changes in microbial community structure and function related to distance from the tree and varying between tree species. In soils adjacent to black walnut, microbial functional diversity and bacterial diversity increased with increasing distance from the tree, whereas in soil under the chestnut tree there were no differences in microbial functional diversity related to distance. Bacterial phylogenetic classes that varied with distance from trees included Bacilli,  $\alpha$ -proteobacteria and  $\delta$ -proteobacteria. Communities under the walnut tree favored simple carboxylic acids and complex carbohydrates. Overall, the soil microbial community 4 m away from each tree was different compared to the pasture soil. These results suggest that soil microbial communities might be under the tree influence even 4 m away from the tree and do not reflect necessarily the pasture signature. These results illustrate the complications of soil sampling in mixed land use systems.

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#### **Effects of environmental richness and habitat switching upon the development of silk deposition behaviors in the wolf spider *Hogna helluo***

All spiders produce silk draglines as they move through their environment and the deposition of this silk may be important for foraging and reproductive success. Previous studies indicate that species that live in densely structured habitats exhibit greater development of dragline-producing silk glands (major ampullate) and produce more draglines than species that do not. Although these studies indicate adaptations of the spinning-apparatus to habitat complexity, there are no studies that have measured developmental behavioral shifts in dragline production as a consequence of habitat-shifts within a species. Here we examined the degree of plasticity in silk depositional behaviors exhibited within the lifespan of the wolf spider, *Hogna helluo* as a consequence of shifting habitats. *Hogna helluo* spiderlings were introduced at an early instar to containers with either simple or complex environments. After one month, half of the spiders in each treatment were removed from their containers and transplanted to containers with the alternate environment type (simple or complex) while the remaining spiders were maintained in their existing containers. We quantified the levels of three types of silk deposition (fine gauge silk, attachment disks, and cord silk) as well as total silk deposition at one week intervals for the duration of the two month experiment. Silk deposition from spiders reared in each environment was measured on standardized gridded substrates. Preliminary results indicate a significant reduction in silk production over the first week after introduction into the

habitat and a marginally non-significant trend toward differential silk deposition as a function of habitat richness.

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#### **Landscape level airborne mercury upstream and downstream from an original point source along the South River, Waynesboro, Virginia**

An industrial source of Hg release into the South River at Waynesboro, Virginia occurred during the first half of the 20<sup>th</sup> Century. While manufacturing activity using Hg is no longer occurring, considerable contamination has entered the river settling its sediments and the floodplain downstream from the original entry point. Soil, water, fish, clam, and other Hg contaminated compartments tend to have higher concentrations downstream which reach maxima between Doods and Crimora; while samples from above the point source are virtually Hg free. This study involved a comparison of three replicate half year duration sample periods in 2003, 2004 and 2005. Samples from about 400 passive air collectors were hot acid digested and analyzed for Hg with cold vapor AA spectrophotometry each year. The samplers were made from Petri plates affixed to telephone poles which exposed a tacky surface, Tangle Trap<sup>™</sup>: for a fixed duration. Dust, vapor and other airborne Hg forms were collected within Waynesboro Virginia both upstream and downstream from the source. The downstream samples had significantly higher [Hg] ( $P > 0.05$ ) than those collected upstream as well as the regional background measured in Staunton, Virginia, 20 km distant from the Waynesboro. This study demonstrates the utility of the samplers for screening airborne Hg at the landscape level. Specific locations within the study area which have consistently greater than the mean concentration are identifiable and this information could be useful in the designing of studies which can be carried out with greater sampling and analytical precision.

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#### **Investigating hemlock (*Tsuga canadensis* [L.] Carriere) stand resistance to hemlock woolly adelgid (HWA; *Adelges tsugae* Annand) infestations**

The vigor of Eastern hemlock (*Tsuga canadensis* [L.] Carriere) stands across the Eastern seaboard and Appalachia is declining due to various invasive pests including the hemlock woolly adelgid (HWA; *Adelges tsugae* Annand). Introduced from Japan, HWA is a sucking insect that feeds on the new growth of hemlocks, which depletes the trees' starch reserves, causes needle loss, and weakens the trees. Hemlocks play an important role in ecosystem functioning. Their dense canopy provides habitat for numerous species and aids in the regulation of stream flow and temperature. The

loss of this long-lived, majestic species from Eastern forests will greatly compromise the integrities of those ecosystems. However, some stands succumb rapidly to HWA infestations while others exhibit less impact and tolerate HWA populations for relatively long periods of time. The causes of this phenomenon are unclear, but are likely linked to differing site characteristics and stand dynamics. This study investigates various site and stand parameters in 8 plots across Blue Mountain, Perry County, Pennsylvania. Factors being measured include: temperature, soil moisture, hemlock density, sapling and seedling distribution, surrounding tree species and density, and elevation. Adelgid populations are being measured by assessing the presence or absence of HWA on 40 sprigs/tree and then calculating a relative measure to compare across plots. The health of individual trees within the plots is also being assessed via crown density ratings and new growth measurements. Results will be presented and discussed. Any significant findings will have implications for hemlock stand management and the control of HWA.

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#### **The impact of urbanization on bumblebee (*Bombus* spp.) populations in southeastern Pennsylvania**

Bumblebee (*Bombus* spp.) populations have declined nationally and worldwide in recent decades. Bumblebees are one of the most effective native pollinators in temperate ecosystems, and it is therefore important to understand the potential role human activity has played in these declines in order to develop effective management strategies for maintaining their populations. We surveyed the abundance and diversity of bumblebee communities in restored meadows located along a gradient of urban and suburban development in the Philadelphia metropolitan area from June 1 to August 15 in 2006. We calculated the proportion of developed land at differing spatial scales ranging from 500 to 4000 m from collection sites. We used general linear models to test the effect of developed land on overall bumblebee abundance and species richness. Development did not affect species richness at any tested spatial scale. Bee abundance was best predicted by a model that included the proportion of developed land at the 2500 m scale. In contrast to our expectations, this model revealed a significant positive relationship between proportion of developed land and overall abundance of bumblebees at a site ( $F = 7.89$ ;  $df = 1, 13$ ;  $P = 0.0376$ ). This somewhat unexpected finding may be explained by a concentration effect. Meadows situated within a landscape largely composed of intensive development may provide resources that are scarce in the landscape, and may thus attract more bees to a smaller area. We discuss additional alternative hypotheses for this finding.

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**Use of partially predated gastropod shells by the hermit crab *Pagurus longicarpus*: Who is predated on the *Littorina littorea*?**

Although many investigations have focused on the importance of shell resources to hermit crabs, few studies have documented how these shells become available to hermit crabs. Field collections of *Pagurus longicarpus* from Long Island showed this hermit crab inhabited *Littorina littorea* shells that exhibited partial predation (soft tissue present but opercula removed). In fact, 28% (n=64) and 4.4% (n=158) of *P. longicarpus* inhabited *L. littorea* shells with soft tissue present from sites along Long Island, New York in 2004 and 2005, respectively. Based on these findings, laboratory experiments were performed to determine if *P. longicarpus* was attacking the snails or inhabiting shells that had been previously attacked by a spider crab predator. To determine the snail predator, *P. longicarpus* or *Libinia emarginata* were placed separately in tanks with live *L. littorea*. Another experiment was conducted to observe the hermit crabs' use of predated snail shells by removing the opercula of snails and offering the snails to hermit crabs in tanks. *L. emarginata* was shown to remove the opercula of *L. littorea* in the laboratory but abandoned the soft tissue, as found in specimens collected in the field. No predation events occurred in the tanks containing *P. longicarpus*. With the opercula removed, the majority of *P. longicarpus* switched shells and chose the partially predated shells. These findings are exciting since no studies along the east coast of the U.S. have focused on the use of such shells by *P. longicarpus* and this behavior may have important impacts on their populations.

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**Anthropogenic mediation of a cross-ecosystem subsidy: The response of terrestrial spiders on bridges to emerging aquatic adult prey**

The importance of subsidies as sources of additional energy to adjoining ecosystems is receiving increased attention by ecologists. However, in many cases the mechanisms controlling these subsidies are naturally derived. Here we investigate the response of a terrestrial predator to a human-mediated aquatic subsidy. Responses of web-building spider populations using the railings of bridges spanning the Susquehanna River in central Pennsylvania were investigated in relation to patterns of aquatic insect prey populations. Potential prey (insects) and spider densities were measured at nine equally spaced locations on seven bridges. Insect and spider densities were also measured along a light-extinction gradient caused by proximity to streetlights. Several insect and spider samples were collected to determine cross-ecosystem trophic linkages using stable isotope signatures. Based on  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$

signatures, aquatic insects constitute a larger proportion of spider diets on bridges than away from bridges. Both aquatic insects and spiders were proportionally more abundant in the middles of bridges than near bridge ends, suggesting that spider densities responded to prey densities. Furthermore, spiders from the middles of bridges had higher  $\delta^{13}\text{C}$  and larger body size relative to spiders at the ends of bridges. Within each bridge, insects (especially aquatic) were more abundant near streetlights with corresponding increases in spider densities. Human construction of bridges enhanced the cross-ecosystem subsidy of aquatic insect prey to terrestrial invertebrate predators by providing predators access to the aquatic resource and concentrating prey densities with artificial lighting.

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**How trophic cascade caused by herbivore and carnivore irruptions in Mid-Atlantic forests affects ecological research: Solutions and research opportunities**

My search experiments for amphibians and reptiles take place in forests. Understanding search results requires understanding the context of the flora and fauna at the search site where the larger picture of deteriorating forests often fails to be understood. "Dilapidated but restorable" describes forests affected by trophic cascade. Trophic cascade (*sensu* Terborgh) begins with loss of top predation, followed by irruptions of a few species of mid-size herbivores and mid-size predators. When you can see 50 to 100 m in summer in a forest plot it is clear that these irruptions can have large effects: saplings are few -- tree reproduction slows or fails, even of dominant oaks. Native ground cover is often sparse or missing, and in places damaging exotic invasive plants are favored by their assumed toxicity during intense unnatural browse pressure. Tick irruptions occur of species whose reproductive adults feed on irrupting mid-size mammals. Because trophic cascade includes release of mid-size carnivores, their population increases can expose prey communities to more predation throughout the year, even where native vegetation cover declines for forest floor animals. Detection of amphibians and reptiles becomes logically difficult where predation intensifies. From search experiments, I report the detection levels of species of a variety of body shapes and sizes of amphibians and reptiles. Results show how detection determines our understanding of population and community structure. Current conditions are explored in flow charts, asking how forest dilapidation affects research and teaching. Flow charts and centrifugal diagrams show eight diverse solutions--some already implemented--as research opportunities.

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#### **Effects of pesticides and larval odonates on parasitic trematode cercariae survivorship**

The decline of amphibian populations continues to be a critical conservation issue but the exact causes of this problem are unknown. Probable factors include chemical pollution and infectious disease as well as interactions between these and other factors. Some trematode parasites are known to cause of amphibian limb deformities, which increase susceptibility to predation, while other trematode species may contribute to amphibian population declines through their impact on physiology. Amphibians are second intermediate hosts for the trematode *Echinostoma trivolvis*, and are infected by free-swimming larval cercariae. Consumption of cercariae by odonate predators may have an indirect positive impact on amphibian populations by reducing the overall number of cercariae but this interaction may also be affected by the presence of agricultural pesticides. In this study, we evaluated the effects of an insecticide, carbaryl, and an herbicide, glyphosate, on the foraging rate of four species of larval odonates in the presence of trematode cercariae. Both damselflies (*Ischnura verticalis*) and dragonflies (*Anax junius*, *Erythemis simplicicollis* & *Sympetrum semicinctum*) significantly reduced cercariae survival. Damselflies were significantly more voracious than dragonflies, and changes in water chemistry did not affect odonate foraging rates. This study clearly indicates disparities in trematode cercariae consumption between dragonflies and damselflies, but the limited scale of these trials makes it difficult to predict long-term effects of pesticides on the feeding rate of larval odonates on trematode cercariae. Future studies under more natural conditions will explore whether the consumption of cercariae by odonate larvae reduces the risk of infection in amphibians.

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#### **Characterization of foodwebs in limestone springs using stable isotopes**

Limestone springs of Pennsylvania support productive ecosystems and fisheries. Autochthonous primary production is dominated by vascular aquatic plants such as watercress, and by bryophytes and algae. Secondary production is dominated by amphipods in less impaired springs, and isopods in more impaired springs. In less impaired springs, vertebrates at higher trophic levels are abundant, with dominants including slimy sculpin, wild trout, herons, and egrets. The objective of this study was to characterize food webs in springs of varied impairment and stocking status using stable isotopes of C, N, and S. Near fish hatcheries or after stocking of trout, isopods

and herons relied strongly on C from hatchery waste or fish ( $\delta^{13}\text{C}$  near  $-21\text{‰}$ ). Amphipods and wild fish in Big Spring following hatchery closure ranged from  $-35$  and  $-40\text{‰}$   $\delta^{13}\text{C}$ , more depleted than vascular C3 photosynthetic plants, indicating partial reliance on non-vascular plants or algae ( $\delta^{13}\text{C}$   $-37$  to  $-49\text{‰}$ ).  $^{34}\text{S}$  in these ecosystem components is being investigated along with  $^{13}\text{C}$  to trace marine organic subsidies (via hatchery feed) to the springs. Hatchery effluent may be utilized directly by pollution tolerant isopods that dominate under impaired conditions. Stocking or raising trout results in opportunistic foraging by predatory birds on raised fish, that may be traced by stable isotopes. Shading of springs by riparian plantings could reduce autochthonous primary and secondary production in less impaired spring foodwebs, although allochthonous C from riparian litter of lesser quality could be utilized by invertebrates given adequate water quality.

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#### **Comparison of visitation patterns and pollen deposition in a "pollination" network**

Communities of flowering plants and their insect pollinators are characterized by complex networks of interactions. The existing data on networks summarize visitation patterns of insects to flowers at the species level, but have been used to infer characteristics of pollination in the community, such as contributions of individual pollinator species to plant reproduction or the amount of conspecific pollen deposited on stigmas. Such inferences assume that the visitation patterns define the resulting pollination processes. We test one aspect of this assumption by comparing the relation between insect visitation patterns to flower and pollen deposition on the stigmas of eight dominant plant species in an eastern grassland. We collected data on insect visitation to the focal plant species on two separate dates and collected stigmas from each plant at the end of each day. We developed simple null models to predict the diversity and proportion of conspecific pollen on stigmas based on patterns of insect visitation to the plant community. We then compared these predictions to observed patterns of pollen deposition based on microscopic examination of stigmas. Preliminary analyses showed large differences between the predicted and the observed amount of conspecific pollen with more grains of the same species observed on stigmas than predicted by the model ( $t=7.35$ ,  $df=15$ ,  $p<0.01$ ). This deviation suggests that visitation of individual pollinators is more constant to single plant species than indicated by the species-level interactions and that pollen carryover affects deposition. The results call for caution when interpreting the functional consequences of interaction webs.

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**Smut fungus disease and host plant density in native, naturalized, and invasive populations of the grass *Andropogon virginicus* (broomsedge)**

*Andropogon virginicus* is a very common early successional old field grass and pasture weed in eastern North America. Its range also includes California, where it is introduced and naturalizing, and Hawaii, where it is identified as an invasive non-native species. I visited populations throughout each range and measured plant density in 1 m wide belt transects, examined plants for the presence or absence of a smut fungus disease caused by *Sporisorium ellisii*, and collected aboveground plant material and seeds for future comparative research on weediness in this species. Eastern native populations are widespread and occurred primarily in open fields and roadsides. They averaged 2.96 plants / m<sup>2</sup>. Out of 41 sampled populations, smut fungus disease was present in 22. California populations occur in the Central Valley region. They are much less common than in the east, and are restricted to continuously moist soils such as riverbanks, pond margins and seeps, presumably because *A. virginicus* can not tolerate the prolonged summer drought in the Central Valley. Plant density in the California populations averaged 2.66 plants / m<sup>2</sup> and smut fungus was not present in any of the 8 sampled populations. In Hawaii *A. virginicus* has colonized large expanses of old lava flows of various ages, especially in Volcano National Park; its habitat ranges from nearly barren lava to pasture lands to early successional forest. Plant density averaged 2.97 plants / m<sup>2</sup> and no smut was present in any of the 18 populations I sampled on Hawaii and Maui.

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**Terrestrial movements of Diamondback Terrapin hatchlings (*Malaclemys terrapin*) on Long Island, New York**

Terrestrial movements of hatchling diamondback terrapins, *Malaclemys terrapin*, are poorly known. Literature suggests hatchlings may migrate either to the water or towards vegetation, but there is little documentation supporting either claim. There have been no in-depth or long-term studies to determine why terrapins behave so differently from other aquatic turtle hatchlings. Aquatic environments can offer hatchlings predator protection and a freeze-proof overwintering location. Vegetated upland locations could also offer predator protection or food availability. My research focuses on determining the terrestrial movements of hatchlings and why they may choose terrestrial locations over aquatic habitats. Eleven drift fences were installed in four areas of Jamaica Bay Wildlife Refuge (JBWR), part of Gateway National Recreation Area on Long Island, New York. Each area had at least two drift fences. Small pitfall traps were placed one meter apart along the fence line, parallel to the fence and submerged up to the top under sand or dirt. I monitored each container

daily before dusk between August 6, 2006 and October 29, 2006. Each captured hatchling was marked, measured, photographed, and placed on the opposite side of the fence under vegetation. Forty-seven hatchlings were found and six were later recaptured. The majority of the hatchlings were moving upland towards vegetation. This study will continue spring and fall 2007.

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**The importance of small-scale environmental factors on population growth of Japanese stiltgrass (*Microstegium vimineum*)**

Most studies of invasive species consider only later stages of successful invasions. However, much insight into the invasion process can be gained by following invasions from their initiation, in sites which may vary in their resistance to invasion. Thirty patches of the invasive annual grass *Microstegium vimineum* were planted in four habitats within a forested landscape in central Pennsylvania in 2003. Recruitment, seed production, and spatial spread were counted in each patch until they were terminated in July 2006. Differences in population growth between habitats were not statistically significant, but showed that in general roadside patches expanded most, while most populations under intact forest canopy declined. Population growth rates varied greatly even among replicates planted into the same habitats. Environmental measurements taken at each plot early in the experiment and repeated in the final year are being used in an attempt to explain this unexpected variation in population growth rates. Preliminary results suggest that small-scale environmental factors have a large impact on the success of *Microstegium vimineum*. Changes in population growth trajectories in response to small-scale environmental changes imply that habitat susceptibility to invasion by this species is not static.

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**Optimizing tree spacing and orientation for forage production in silvopastoral systems: Insights from a spatially-explicit light capture model**

Silvopastoral management attempts to optimize the biophysical interactions between pasture species, woody perennials, and grazing animals to increase production efficiency and sustainability of the entire system. Detailed knowledge of resource capture, allocation, and distribution on a given site is required to design patterns of tree location and position relative to landscape features to synchronize forage quantity and nutritive value with grazing animal production requirements. We evaluate the use

of a spatially-explicit, geometric-optimal light capture model (tRAYci) as a tool for assessing light capture and allocation within silvopastures. tRAYci was parameterized for two tree species commonly used in agroforestry systems that have different crown architectures and growth habits: black walnut (*Juglans nigra*) and white pine (*Pinus strobus*). Light reaching the ground surface (expressed as a percentage of above canopy radiation [ACR]) was estimated at 2,500 individual points within a simulated 0.5 ha plot and sensitivity analyses conducted to determine the effects of spacing, row orientation, and foliage density on the distribution of light availability for forage production. Spacing and orientation were varied in combination to maximize light availability within the plot in the range of 40-70% ACR, a range considered suitable for forage production. Results from these sensitivity analyses indicate that individual-based light capture models offer the potential for designing systems to optimize light allocation for tree and forage components of silvopastures by quantifying patchiness resulting from different tree distribution patterns.

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#### **Impact of extrafloral nectaries on herbivore damage in *Prunus serotina***

Many plants produce extrafloral nectar to attract ants and other animals, which in turn, defend the plant against herbivores. Extrafloral nectaries have been observed in various *Prunus* species. A descriptive study was initiated to examine the relationship between extrafloral nectaries and herbivore damage in *Prunus avium* and *Prunus serotina*. Leaves were collected from both *Prunus avium* and *Prunus serotina* along a hedgerow in Selinsgrove, Pennsylvania. Both the total leaf area and the leaf area damaged by herbivores were measured. For each leaf, the extrafloral nectaries were counted, measured, and their positions on the leaf were recorded. Analysis of the data showed a relationship between the number of extrafloral nectaries and the amount of herbivore damage. Leaves with high numbers of extrafloral nectaries had lower levels of herbivory in both *Prunus* species. A greenhouse study was initiated to look at the mechanisms underlying the development of extrafloral nectaries in the *Prunus* species. Specifically, the experiment explored how abiotic factors, such as light and nutrients, affect extrafloral nectary development. We found a significant relationship between amount of light *Prunus serotina* seedlings received and the number of extrafloral nectaries that developed. EFN number was significantly higher for seedlings grown in ambient light relative to those grown in shade. There was also a significant interaction between light and fertilizer, where seedlings that received both ambient light and weekly fertilizer developed more EFNs than all other treatments. We are currently exploring how these abiotic factors that influence extrafloral nectary development affect herbivory in the field.

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#### **The contributions of specialist and generalist bees to the reproduction of desert mallow (*Sphaeralcea laxa*)**

Many pollinator communities are composed of species that differ in their visitation patterns. Specialists limit visitation to one or a few related plant species, whereas generalists visit a variety. Specialists are often considered highly effective pollinators because they visit primarily a single species and so deposit mostly conspecific pollen. However, if generalists visiting the same plant are very abundant, they might swamp out pollination by specialists. Despite the importance to understanding floral evolution, the contributions of specialist versus generalist pollinators remain largely unknown for any plant species. We quantified these contributions of specialist and generalist bee species to the reproductive success of *Sphaeralcea laxa* (desert mallow) in two in the Chihuahuan desert during July and August of 2005 and 2006. We compared the fruit and seed set following single visits by the dominant generalist and specialist bees and measured visitation rates over multiple days. Single-visit seed set did not differ between specialists and generalists ( $F = 2.09$ ;  $df = 1, 13$ ;  $P = 0.15$ ), although some individual species were significantly better pollinators. Visitation rates differed among bee species ( $F = 56.9$ ,  $df = 16, 8619$ ;  $P < 0.001$ ), but like for per visit pollen deposition, specialists did not consistently differ from generalists. No single pollinator species emerged as both very abundant and a highly effective pollinator. We discuss the implications of this pattern for plant reproduction and floral evolution.

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#### **Unexpectedly slow spread of the invasive exotic *Microstegium vimineum***

*Microstegium vimineum* (Japanese stiltgrass) is a nonnative weed of particular concern in forests, where it threatens native diversity and interferes with forest regeneration. It has been reported to invade entire forests in Maryland and Pennsylvania in a time span of less than 10 years. To study the dynamics of small populations of *Microstegium*, 30 patches were established in 2003 in different habitat types (roadside, intact forest, disturbed forest and wetland areas); subsequent population growth and spatial expansion were monitored until plots were terminated in 2006. The patches expanded surprisingly slowly for a species reported to invade large areas so quickly: the furthest distance new seedlings were found beyond the original

patch area was 4 m in the four years of the experiment. Most expanding patches were only slightly larger than in the first year; in the final year, the majority of new seedlings were still within 1 m of the original patch. We developed a spatial model of patch growth, using maximum likelihood techniques to estimate dispersal and population growth parameters. The long-term projections of this model suggest much slower spread than has typically been observed for *Microstegium*. The relatively small scale of natural dispersal suggests that human-mediated dispersal, likely influenced by forest road management, is responsible for the rapid spread of this invasive species.

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#### **Evaluating the ability of different wetland species to remove iron within constructed wetlands to treat abandoned mine drainage**

Abandoned mine drainage (AMD) is the largest source of pollution to streams in Pennsylvania. Over the past fifteen years, a variety of organizations have sought to ameliorate AMD through use of constructed wetlands. Those systems work by filtering heavy metals, primarily iron, from contaminated water. The relative ability of different plant species to act as filters is less understood. To gain some insight into iron-removal efficiencies, three plant species common to AMD-treatment wetlands in northeastern Pennsylvania (*Typha latifolia* – cattail; *Juncus effusus* – softrush; and *Sparganium* sp. - bur-reed) were planted within troughs measuring 18' x 8" x 8" in a constructed wetland in northern Luzerne County, Pennsylvania operated by the Earth Conservancy. Water quality measurements were taken at periodic intervals beginning late November 2006. Preliminary findings suggest that *Sparganium* provides more effective iron removal than the other species, primarily because it produces broad, flat leaves that act as binding sites for iron particles. The results of this investigation can help guide vegetation planting and management within AMD wetlands.

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#### **The effects of shading on the growth and morphology of the threatened seagrass *Halophila johnsonii***

*Halophila johnsonii* grows in the intertidal and shallow subtidal regions of the Indian River Lagoon in eastern Florida. This seagrass has a limited distribution spanning 200 km of coastline in eastern Florida. Because of its limited distribution and ability to reproduce only by vegetative growth or fragmentation, there are concerns of how light

limitation resulting from overwater construction, turbidity, or other water quality reductions could affect *H. johnsonii*. To test this question, we conducted a short-term field experiment and two long-term laboratory experiments to explore the effects of light level on the growth and morphology of this seagrass. We measured the number of leaf pairs on a plant, the timing of emergence of new leaf pairs, the distance between leaf pairs along rhizomes, the size of each leaf, presence or absence of a branch created at each leaf pair, and the number of leaf pairs on each branch in plants grown under full ambient light (controls) and light reductions to 60% and 30 % of ambient light. Most parameters did not indicate an effect of light reduction to 30 % of ambient sunlight on *H. johnsonii*; however, the results of our first laboratory experiment indicate that plants exposed to control conditions have greater lengths between leaf pairs. This may have important implications for the spreading of individual plants and on the patch dynamics of this threatened seagrass growing under compromised light conditions. We will use these data to construct a spatially-explicit individual-based model of patch dynamics under different light conditions.

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#### **Seed germination in native, naturalized, and invasive populations of the grass *Andropogon virginicus* (broomsedge) grown in a common environment**

*Andropogon virginicus* is a C<sub>4</sub> perennial grass that colonizes old fields in its native range in eastern North America. It is naturalized on moist soils in California and has become invasive in the Hawaiian islands. We collected *A. virginicus* from each of these regions and compared seed germination in a common greenhouse environment. For weedy and invasive plants both germination speed and quantity may be important components of their success during colonization in competition with other vegetation. Also, our study system is characterized by the presence of *Sporisorium ellisii*, a smut fungus, which appears to be restricted to certain native broomsedge populations. Early germination and growth may be advantageous when smut fungus is present, since the youngest germlings are often the most vulnerable to infection. We planted 50 seeds (a seed family) from each of 20 seed mothers from each sampled population, and measured two-week germination rates and maximum germination rates for each family. There was highly significant variation among populations within regions for both variables, but not among regions. Mean maximum germination ranged from 14.4% to 49.3% in eastern, 12.3% to 63.0% in Californian, and 0.0% to 52.9% in Hawaiian seed families. Mean two-week germination ranged from, 2.0% to 46.9% in eastern, 8.1% to 60.8% in Californian, and 0.0% to 47.0% in Hawaiian seed families. Germination did not differ among families from smut-infected versus healthy populations. Local rather than regional conditions appear to be driving genetic divergence among populations for the key life-history component of seed germination.

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#### **Foraging and growth costs of habitat switching in the wolf spider *Hogna helluo***

Generalist animals are able to survive in diverse habitats but likely suffer fitness-related costs when moving from one habitat to another. Further, the fitness costs are unlikely to be symmetrical when moving between complex and simple habitats. The wolf spider *Hogna helluo* is a model species to study the effects of rearing environment and habitat switching on foraging performance. *Hogna* lives in agricultural fields which are subject to dramatic modifications within the lifespan of the spider. We randomly assigned 80 juvenile *Hogna* to two experimental habitat types (simple and complex). Habitat treatments varied only in their physical structure and consisted of plastic shoebox containers with either a topsoil substrate (simple) or topsoil with artificial grass and coffee stirrers on top (complex). For each habitat treatment, we collected data on spider foraging success including prey capture latency, growth rates, body condition, and mortality during a one-month period. We then divided each treatment into two sub-groups and randomly assigned half the spiders to the reciprocal treatment (simple or complex) while retaining half the spiders within their existing treatment. For one month we then measured the same variables again after habitat reassignment. Preliminary results indicate *Hogna* raised in more complex environments showed significantly longer prey capture latency initially as well as one month after introduction. Despite reduced prey capture success, we found no significant difference in spider body condition or growth rates among treatments. This suggests compensatory nutrient extraction from prey or differences in time allocated for foraging among spiders in complex habitats.

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#### **Coexistence of rattlesnakes and military operations: Occurrence and spatial ecology of the timber rattlesnake (*Crotalus horridus*) at the Warren Grove Gunnery Range in the Pinelands of New Jersey**

*Crotalus horridus* is a state-endangered species and occurs as a disjunct population in the Pinelands of southern New Jersey. The Warren Grove Gunnery Range (WGR) occupies 3810 hectares of upland pine-oak forests, wetlands, and disturbed sites created by military operations. During fall 2002 - fall 2004, we used radio telemetry to monitor the home range and movements of three female and six male *C. horridus*. Radio-tracked snakes did not enter the immediate vicinity of the target zone. Incidentally captured and radio-tracked snakes exhibited an affinity for wetland habitats compared to upland habitats. There were no significant differences in home range size, seasonal activity, core activity area, range length, distance traveled per day, or seasonal differences in movements between male and female snakes. *C.*

*horridus* utilized hardwood swamp habitat proportionately more than six other habitat types at WGR. In addition to quantifying movement behavior we found 12 hibernacula in undisturbed wetland habitats and we observed *C. horridus* mating and reproducing. It appears that military operations are not significantly impacting the *C. horridus* population at WGR. The population of *C. horridus* and military operations coexist on WGR because they occur in different areas. Our results support the conclusion that WGR is an important refuge for *C. horridus* in the Pinelands. To fully understand the long-term effects of military operations on *C. horridus*, it will be necessary to conduct a more comprehensive demographic study focusing on the reproductive success and survivorship of individual rattlesnakes of different sizes and sexes over several years.

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#### **Vegetative influence on reducing agricultural pollutants associated with subsurface tile drainage within a novel constructed wetland**

Pollution from agricultural run-off is a significant contributor to the eutrophication and declining health of global surface waters. Often agricultural chemicals are transported off site in subsurface tile drain lines to surface waters. Our research examined a novel recirculating vertical flow constructed wetland (RVFCW) as a means to collect, treat, and reuse tile drainage waters. The RVFCW is comprised of three modules: a vegetated layer, a filtration module and a final aerobic phase. Four vegetated and three un-vegetated RVFCW bench scale models were compared. A synthetic tile water, nitrate (25 mg/L NO<sub>3</sub><sup>-</sup> N), reactive phosphorous (0.19 mg/L) and TOC (3 mg/L) was used. Vegetated units (*Carex stipata*) were compared to non-vegetated units and to units with native weeds. Systems were recharged twice a week with 20 L of tile water. After four months, vegetative units aerobically reduced nitrate loads by an average of 62%. Phosphorous removal remained steady in all units. Nutrient load reductions were increased as HRT was increased. Results indicated the potential for significant nitrate reduction in aerobic, vegetated treatment systems. The largest nutrient load reductions and evapotranspiration rates were observed in systems comprised of native southeast Pennsylvania weeds, demonstrating possible phytoremediative potentials for these species.

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#### **The effects of light differences on leaf damage in *Cercis canadensis***

Tree leaves can experience damage ranging from spots of fungal growth to areas of damage caused by herbivorous insects. Damage that results in a decline of

photosynthetic rate per leaf may lead to decreased tree growth or overall tree viability. *Cercis canadensis* is a native deciduous tree. In the Fredericksburg, Virginia area, *C. canadensis* grows in light and shade environments. Across these microclimates *C. canadensis* incurs a variety of leaf damage caused by one or more of the following: fungal disease, skeletonizing insects, lesion-creating insects, and tissue-removing leafhoppers. The objective of this study was to determine if differences in light environments impact percent leaf damage. Leaves were sampled during early and late summer from four different sites containing light and shade trees. The early sample, consisting of 400 leaves, was analyzed to determine total percent leaf damage and percent leaf damage from four types of damaging agents. There was no significant difference in total percent damage between the two light environments ( $F = 3.575$ ,  $df = 1$ ,  $p = 0.063$ ) nor was there a significant difference in the amount of lesions or diseased areas. However, damage attributed to leafhoppers exhibited significance with greater percent damage in shade trees at three of the four sites ( $F = 8.55$ ,  $df = 1$ ,  $p = 0.005$ ). Results to date suggest shade trees incur a greater photosynthetic loss due to damage by leafhoppers than light trees.

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#### **The effects of indirect predation risk on male courtship displays through female sexual advertisement in the wolf spider *Pardosa milvina***

Females of the wolf spider, *Pardosa milvina*, advertise sexual receptivity toward males via pheromone-laden silk draglines and male *Pardosa* exhibit conspicuous species-specific courtship (leg-waving and tapping) when encountering silk from unmated females. Previous studies have shown that: 1) silk and excreta produced from the larger co-occurring predatory wolf spider, *Hogna helluo*, induces adaptive antipredator responses (immobility) in *Pardosa*, 2) the presence of *Hogna* silk causes significant reductions in male *Pardosa* courtship behavior when encountering conspecific female silk, and 3) *Hogna* is preferentially attracted to silk and excreta deposited by females when previously fed *Pardosa*. Taken together, these studies suggest that 1) female *Pardosa* may benefit by limiting silk advertisements and excreta deposition when encountering silk from the predator, *Hogna* and 2) male *Pardosa* may exhibit reductions in courtship when encountering silk from females previously exposed to *Hogna* silk. In this experiment we compared the amount of silk and excreta deposited by unmated female *Pardosa* exposed or not exposed to predator cues from *Hogna*. We also measured and compared male *Pardosa* courtship intensity and duration in the presence of silk from females previously exposed or not exposed to predator silk from *Hogna*. Preliminary results indicate a significant increase in excreta deposition in the presence of predator cues. However we found no significant effect of predator cues on the quantity of silk deposition among unmated females. Increased excretion

may be a maladaptive stress response to the presence of a predator or may serve to prepare the spider for rapid escape.

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#### **The use of passive samplers to examine landscape level patterns of distribution of airborne mercury in Rockingham County, Virginia**

The cities of Harrisonburg and Staunton, Virginia, were selected for use as background concentration control sites for a study of airborne Hg related to industrial contamination in Waynesboro, Virginia. Both of these cities were geographically distant from the known contamination and low [Hg] was expected. Staunton served as a good control; concentrations were well below average for the study. However, Harrisonburg had a few locations which revealed [Hg] similar to those in the contaminated section of Waynesboro. Two potential sources came to mind: a trash incinerating facility located within the city limits and the historical (pre-1960's) agricultural use of Hg as a fungicide in the extensive patches of orchard in the surrounding Rockingham Co. Virginia. The surveys were carried out for a fixed duration with passive samplers made from Petri plates which exposed a tacky surfaces of Tangle Trap<sup>™</sup> to collect dust, vapor and other airborne Hg. They were affixed to telephone poles. In the current study, the research area was expanded into Rockingham Co. in order to examine correlations between land use and airborne [Hg]. Many locations had low concentrations, representative of regional background conditions; however, additional locations were found with Hg contamination. These data were mapped in a GIS to obtain a picture of the geospatial distribution. Nearness to old orchards may have been a contributory factor, but it is clear that other variables are involved. Additional sampling has followed this initial study and the data are still being processed.

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Bowman's Hill Wildflower Preserve, New Hope, Pennsylvania 18940

#### **Introduction to the Plant Stewardship Index or "floristic quality does count!"**

This presentation will offer an overview of the Plant Stewardship Index and its applications in monitoring and assessing the vitality of native plant communities. The Plant Stewardship Index (PSI) is an analytical tool developed by Bowman's Hill Wildflower Preserve to allow land stewards to survey and assess the vitality of native plant communities on the properties they protect and manage. Adapted from the Floristic Quality Assessment Index (FQI) methodology developed by Swink and Wilhelm et al., the PSI is based on the concept of ecological conservatism. This is expressed numerically as a coefficient of conservatism or C value, as determined by a

panel of botanists expert in the region in question. C Values range from 0-10, with 0-3 indicating plants with a high range of ecological tolerances that may be found in a variety of plant communities and 9-10 indicating plants with a high degree of fidelity to a narrow range of habitats. Bowman's Hill Wildflower Preserve has introduced a free online interactive PSI calculator that enables researchers to automatically compute both the FQI and PSI for any site-based plant list. In addition, Bowman's Hill is offering trainings in the methodology to conservation organizations and municipal officials in the hopes of influencing resource policy and enabling land managers, granting agencies and municipal officials to monitor and quantify the results of their land management practices.

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**Plants, bones, hairs, and flesh: Feeding ecology of two sympatric foxes in central Pennsylvania**

Since gray (*Urocyon cinereoargenteus*) and red foxes (*Vulpes vulpes*) are sympatric carnivores, we expect some level of resource partitioning as a result of these two species occupying similar niches for the last 200-300 years. With this in mind, we examined and compared diets of gray and red foxes in central Pennsylvania. Samples were collected from animals provided by members of the Pennsylvania Trappers Association. Skulls and stomachs were removed from each specimen and labeled accordingly. Following museum standards, the skulls were cleaned and used for identification purposes. Each stomach was emptied and its contents were separated macroscopically into plant matter, hairs, bones, flesh, and others. We used bone and hair remains to identify samples to species level. Bone samples were recognized and classified using a comparative reference collection. When hairs were present, a cast of their scale pattern was prepared and compared against a set of *ad hoc* dichotomous keys. If preliminary data reflects diet differences between red and gray foxes in central Pennsylvania, we hypothesize that perhaps we can use resource partitioning and/or character displacement to explain the fact that these two species remain sympatric.

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**Disappearing anurans: An auditory chronicle of the decline of four species of anurans in south central Pennsylvania**

Observations and tape recordings from the late 1960s to present document four species of anurans that have declined or disappeared from their habitats in south

central Pennsylvania. This presentation will chronicle, with recorded calls and photographs, the decline of the Gray Tree Frog, *Hyla versicolor*, and the Spadefoot Toad, *Scaphiopus holbrookii*. Also, the complete disappearance of the Upland Chorus Frog, *Pseudacris feriarum* and the Northern Cricket Frog, *Acris crepitans* in the study area. Observations were made yearly at nearly 40 wetlands in six counties. Data indicate an abrupt decline and disappearance of the Upland Chorus Frog and Northern Cricket Frog.

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**The use of ribbed mussels (*Geukensia demissa*) as bioindicators of bacterial levels relative to the water flow rate at various watersheds within Mamaroneck Harbor**

Ribbed mussels (*Geukensia demissa*) were collected weekly from May to October 2006 within Mamaroneck Harbor (outside the Gunderboom® at Harbor Island Park, Shore Acres Beach and Guion Creek). Mussels were also collected from a pristine beach, Read Sanctuary, Rye, as a control. The amount of *E. coli* and coliform bacteria recovered from mussels were analyzed using 3M Petrifilm™ plates. Water flow rate was also measured at each site. Our results indicated the mussels from Guion Creek had significantly higher bacterial levels, as well as the lowest water flow rates when compared to other 3 sites. However, the control beach, Read Sanctuary had the lowest bacterial levels and highest water flow rate. The amount of bacteria collected from mussels from outside the Gunderboom® was similar to nearby private Shore Acres Beach and both beaches had similar water flow rates. These results indicated that bacterial loads recovered from the mussels might correspond to their respective water flow rates.