

MID-ATLANTIC ECOLOGY CONFERENCE 2004 ABSTRACTS

The Plum Creek Wetlands mitigation project

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The purpose of this project was to design and construct an ecologically sound restoration wetlands to mitigate a jurisdictional encroachment. The Plum Creek Wetlands Mitigation Project consists of an old agricultural field in Plum Creek Park, a holding of the Medina County Park District, Medina County, Ohio, USA. A portion of the site will be restored to satisfy mitigation requirements associated with U.S. Corps of Engineers and Ohio EPA permits. The mitigation specifics had been negotiated with the regulatory agencies as an off-site, out-of-kind, construction/restoration. Based on the current ecological and regulatory literature and practices, I designed a conceptual plan to accomplish the requirements set forth by the regulatory committees. This plan included: 1) goals/objectives for the type of wetlands, 2) construction design, 3) planting/seeding specifications, and 4) a five-year monitoring program. The construction plan called for 3.5 acres of shallow, seasonally inundated meadow that will eventually develop into wooded wetlands. The site currently has patches of herbaceous wetlands vegetation with adjacent existing wooded wetlands as seed source for colonization. The mitigation plan also included a planting program that included herbaceous and woody hydrophytes. A monitoring schedule was created to assess the short and long-term success of the project. Basin excavation occurred in November 2003 and planting will proceed in spring 2004. The project provides a case history of how an understanding of basic information about wetlands ecology can be used in applied restoration work.

A comparison of regional and local sources of atmospheric mercury deposition in Waynesboro, Staunton and Harrisonburg, VA

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The presence of Hg in plants and animals living on the floodplain of the South River downstream from an industrial source in Waynesboro, VA, has been previously demonstrated. This site in the center of Waynesboro, VA, was the source of inorganic and elemental Hg release in the first half of the 21st century. It is no longer actively using the metal. Some Hg associated with leaves of plants in communities located on Hg contaminated floodplain soils (10 to 50+ $\mu\text{g/g}$) may be attributed to translocation (particularly in young herbaceous plants). However, a major source for above ground organs is likely atmospheric deposition because it is also present associated with leaves of plants growing on uncontaminated soils. Pairs of inexpensive passive atmospheric deposition collectors were attached to telephone poles at 115 locations in Waynesboro city. Plates were placed at 25 urban locations each in Staunton, VA, and Harrisonburg, VA; which are respectively 20 and 60km removed from the contaminated South River floodplain. The collectors consisted of plastic petri plates with a thin film of "tanglefoot" (a gum used to trap insects) which accumulated dust, insects and other atmospheric inclusions over a five month period. The gum and its inclusions were then hot acid digested and analyzed for Hg using a Perkin-Elmer FIMS Atomic Absorption Spectrophotometer. Traces of atmospheric deposition were

detected and this information is used to develop hypotheses for further investigation.

Impacts of nitrogen additions on soil respiration, litter chemistry, and forest growth in a temperate deciduous forest

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Atmospheric nitrogen deposition is an increasing problem in temperate forest ecosystems in the eastern U.S. To examine effects on ecosystem processes, a nitrogen addition experiment has been conducted at the Bousson Experimental Forest, a temperate deciduous forest since 1993 to examine potential impacts on soil processes and forest growth. Fertilized plots have received nitrogen fertilizer at $100\text{kg N ha}^{-1}\text{yr}^{-1}$ (NH_4NO_3). After 9 years of N additions, soil respiration was reduced 11% annually. In the 10th year, soil respiration on comparable annual dates indicates further decreases of up to 1.36% in the fertilized plots (Control: 6.33%, Fertilized: 7.69%). Forest biomass, averaging 559 and 586 Mg ha^{-1} in the control and fertilized plots, respectively, shows no difference in annual growth (Control: $11.49 \text{ Mg ha}^{-1}\text{y}^{-1}$; Fertilized: $11.45 \text{ Mg ha}^{-1}\text{y}^{-1}$). Additional research includes examination of foliar C:N chemistry.

Influence of insect galls on the reproduction of goldenrod: A test of the Plant Vigor Hypothesis

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We tested the Plant Vigor Hypothesis, which predicts that gall-making insects will preferentially attack the tallest, most robust ramets. We also tested whether host preference will vary with host plant neighborhood height. We compared the impact of two stem galling insects (the ball gall *Eurosta solidaginis* and the rosette gall *Rhopalomyia solidaginis*) on the growth and reproduction of meadow goldenrod (*Solidago altissima*). In addition, we excluded insect herbivores (but not gallmakers) in a subset of the plots to determine whether gall-making insects would preferentially parasitize plots with greater stem height. We marked approximately one thousand ramets in early spring and followed their fate with and without leaf chewing herbivores for one growing season in an old-field in central New York. The mean height of the galled stems was significantly taller in the herbivore-excluded plots than in the control plots. Additionally, a greater proportion of ramets in the herbivore-excluded plots was galled. Our findings support the Plant Vigor Hypothesis, demonstrating that ramets from robust clones that emerge early in the spring are more likely to suffer the negative effects of gall-making insects.

The effect of predator hunger on chemically-mediated antipredator responses and survival in the wolf spider *Pardosa milvina* (Araneae: Lycosidae)

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The wolf spider, *Pardosa milvina*, exhibits antipredator behavior when detecting silk and excreta from a larger co-occurring wolf spider, *Hogna helluo*. Since the quantity and quality of silk and

excreta may vary with the hunger state of the predator, we tested if cues from hungry vs. satiated *Hogna* would influence *Pardosa* activity level and survival. *Pardosa* activity was measured on substrata containing chemical cues from 1) a satiated *Hogna*, 2) *Hogna* withheld food for 2 weeks, or 3) a control consisting of a blank test container (N = 20/treatment). *Pardosa* response was recorded on each substratum over a 30-min period using video-tracking equipment (Videomex I). We then measured *Pardosa* survival in the presence of live hungry and satiated *Hogna* on each respective substrate treatment or a blank control substrate in a fully factorial design. Results indicate *Hogna* cues significantly reduced *Pardosa* activity level and that *Pardosa* show significantly less activity in the presence of cues from a hungry *Hogna* than a satiated one. Predator hunger state and substratum type significantly affected *Pardosa* survival in the presence of live *Hogna*. However, cues from hungry vs. satiated *Hogna* resulted in no difference in *Pardosa* survival nor was there a significant interaction between *Hogna* hunger state and substratum type on *Pardosa* survival. In summary *Pardosa* can discriminate between hungry versus satiated predators based on silk and excreta cues alone, but differences in behavior as a result of this discrimination did not translate into increased survival in the presence of a live predator.

The effect of urban land use on stream temperature regimes in the Gwynns Falls and Jennifer Branch (Cub Hill) watersheds

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We report on stream temperature loggers that were installed at three locations near a flux tower in Cub Hill, Baltimore County. In addition, we compare these measurements to long-term monitoring of stream temperatures at eight of the nine Baltimore Ecosystem Study stream gauging locations. In the Cub Hill area, loggers were placed in a first order stream draining a high density residential area, a first order stream draining a medium density residential area, and in the main stem of Jennifer Branch, a second order stream whose drainage includes the first order streams mentioned above. Data from July and August 2003 indicate that Jennifer Branch, the larger stream, is typically less than 1° C warmer than stream water from the high density watershed and more than 2° C warmer than that from the medium density watershed. Additionally, we see diurnal variation in the temperature differences between the small streams and the larger one. Differences are more pronounced in the late afternoon to early evening, and less pronounced mid-morning. Exceptions occur during storm events when the high density watershed temperatures exceed those of Jennifer Branch and medium density watershed temperatures closely approach them. Storm events are marked in all three locations by abrupt temperature increases breaking from normal diurnal patterns. Long-term stream temperature data in the Gwynns Falls indicate that downstream temperatures (urban) are significantly higher by 2-4 ° C than upstream temperatures (forest). Moreover, suburban watersheds were consistently higher by 2-6 ° C in temperature than forested watersheds.

Modes of selfing in *Fragaria virginiana*

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Hermaphrodites of *Fragaria Virginian* (Rosaceae), a gynodioecious (females and hermaphrodites co-exist) perennial herb, are capable of both outcrossing and self-pollination. Self-pollination may theoretically occur via autogamy (within a flower) or geitonogamy (between flowers). *F. virginiana* is pollinated by small bees and flies, a fauna which is not typically thought to affect geitonogamy. We aimed to test this assumption by observing pollinator behavior and measuring outcrossing rates. We have documented an increase in visitation rate, as well as an increase in geitonogamous visits with an increase in floral display size. Also, paternity tests we performed to determine rates and modes of self fertilization on experimental plants confirm that both autogamy and geitonogamy contribute to selfing. Our findings on the hermaphrodites of this gynodioecious species may have broader implications for the questions surrounding the evolutionary transition from hermaphroditism to dioecy.

Foraging ecology of black-crowned night herons (*Nycticorax nycticorax*) in the New York City area.

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Over 1,500 pairs of colonial wading birds (e.g. herons, egrets, and ibis) breed and forage in the industrialized ecosystem of metropolitan New York City. Wader colonies are located on seven islands, from western Staten Island to Long Island Sound. The Black-crowned Night Heron (*Nycticorax nycticorax*), a mainly nocturnal forager, is the predominant breeding wader in these colonies, and has been undergoing population declines both locally and region-wide. Research on foraging success and habitat use, important components of reproductive success, has concentrated on diurnally foraging waders in the New York City area; foraging of nocturnal species (e.g. *N. nycticorax*) has not been examined to the same extent. From March to August 2002, I conducted weekly surveys by car and canoe to describe *N. nycticorax* night-time abundance and foraging success (via focal foraging observations) at 30 sites of three habitat types (shoreline, salt marsh, freshwater) in the Staten Island area. In 2002, salt marsh habitats had fewer foraging *N. nycticorax* per hectare than either freshwater or shoreline habitats. Conversely, salt marsh and shoreline foragers had higher strike rates and capture success than freshwater foragers. By describing foraging habitat use and foraging success for *N. nycticorax*, more inclusive conservation and management plans for local wader populations are possible.

Island biogeography at a microscale: Species – area relationships between diatom taxa in Penns Creek, Pennsylvania

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Over the past two years we have studied the Species–Area relationships between diatom taxa and the surface areas of their substrates in Penns Creek, Snyder County, Pennsylvania. In one study we examined 64 rocks and found a strong relationship between the diatom species (50 taxa) and rock surface area ($R^2=0.93$). In a second study, we attempted to control for variations in rock shape, size, and composition by deploying 50 ceramic tiles as artificial substrates in four different sizes (4.1, 7.1, 10.62, and 14.92 cm²). Also, we tested the occurrences of diatoms on tiles that share the same surface area but are different shapes and orientations in the creek. We collected the diatoms from our

substrates (both rocks and ceramic tiles) by scraping them. Then, we acid-cleaned the frustules for examination with light and scanning electron microscopy. By this method, the total number of diatom taxa observed in both studies was 50 and 55, respectively. We applied the Markov Chain Monte Carlo test to the occurrence data and found that substrates in the small and midrange sizes (both rocks and tiles) showed strong nonrandom distributions (> 9s.d. above the mean).

Nitrogen additions reduce microbial respiration in temperate forest soils at the Harvard Forest LTER

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At the Harvard Forest Long-Term Ecological Research, red pine and mixed deciduous forests showed immediate changes in soil respiration following nitrogen additions (50 and 150 kgN ha⁻¹ yr⁻¹) during the initial study year (1988). The pine site showed an immediate 20% decline in annual respiration (control: 429.9 ± 41.9 g C m⁻²y⁻¹; high N: 358.7 ± 32.0 g C m⁻²y⁻¹); reduced respiration was also observed in the second year. The hardwood site, in contrast, experienced an initial increase in annual soil respiration rates in the first year, however, in the second year, respiration in fertilized plots were not different from the control. Soil respiration during summer 2001 shows that long-term continuous nitrogen fertilization continues to reduce respiration. For the red pine stand, field rates of total soil respiration in the high N plots were 38% lower than the control plots. Similarly, laboratory respiration rates from high N, root-free soil were 44% lower than rates from control, root-free soil. In the hardwoods, summer 2001 field rates of total soil respiration in the high N plots were 41% lower than rates in the control; laboratory respiration from high N, root-free soil were 43% lower than the control, root-free soil. Reduced respiration in laboratory-incubated soils and in field respiration indicates that nitrogen additions have reduced the rate of microbial activity, contributing to the decrease in CO₂ production measured in the field.

Scared to death: Prolonged exposure to predator chemical cues increase mortality in wolf spiders

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The wolf spider *Pardosa milvina* shows effective antipredator behavior (reduced activity) in the presence of chemical cues (silk and excreta) from a larger syntopic species of wolf spider, *Hogna helluo*. We measured the effects of prolonged exposure (21 days) to *Hogna* cues and prey availability on *Pardosa* body condition and survival. We used a 3x4 factorial design (n = 17-23/treatment) with three feeding levels (1 prey/wk, 4 prey/wk, or unlimited food) and four predator cue exposure levels (constant exposure to fresh *Hogna* silk and excreta, constant exposure to *Hogna* cues that were not renewed, or intermittent exposure to fresh cues [intervals of 2 days with cues-2 days without], and no predator cues). We found that the presence of renewed or non-renewed predator cues significantly increased mortality of *Pardosa* relative to intermittent or no predator cue exposure.

Feeding level did not significantly affect mortality. Both feeding level and predator treatment significantly influenced body condition over the testing period. Intermittent exposure to predator cues had no significant impact on body condition or mortality. *Pardosa* appears able to behaviorally compensate for periods of high predation risk when risk is temporally variable; however, prolonged exposure to predator cues may have indirect but lethal effects on prey. Indirect lethal effects may not be frequently observed under field conditions because of the mitigating effects of temporal variation in predation risk. Nonetheless, our results suggest that the long-term influence of predator-induced stress on prey survival may often be underestimated.

Innovative environmental education contributes to improved management practices in the Mid-Atlantic

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The Mid-Atlantic Integrated Assessment (MAIA) is developing and testing methods to translate technical material for managers.

EPA and others fund many environmental research projects. Some of the research results are being used, but MAIA has found a lag between completion of research and actual use of the results. A process is being developed to evaluate research results and tech-transfer those results to decision-makers.

Unique approaches to solve environmental problems have also been implemented by organizations throughout the mid-Atlantic region. Frequently, these new methods have not been tech-transferred to others. A graduate seminar has been developed where students prepare reports on environmental "best practices." Each student selects a project from those provided by MAIA relevant to his or her field of study. The student conducts relevant research and interacts with points-of-contact to develop the case study. Case studies that meet appropriate professional standards are produced as full color MAIA publications with graphics. This seminar is currently given at the University of Maryland, Baltimore County, and the University of Pennsylvania and will soon be taught at universities throughout the Mid-Atlantic region. It will provide students an opportunity to experience the application of science to management issues.

MAIA is working with EPA's Science To Achieve Results (STAR) grant program and others to produce a series of publications based on environmental research and best environmental practices. The success of this project will enhance the use of good science for environmental decision-making and shorten the time it takes to transfer scientific results to environmental managers.

Acid-mine and sewage effluent: Effects of Shamokin Creek on the Susquehanna River

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We examined the biological effects of both acid-mine and sewage effluent on the Susquehanna River from Shamokin Creek in Northumberland County, Pennsylvania throughout the Fall of 2003. We used the occurrences of diatom species on diatometers and scrapings from submerged rocks and wood to document the influence and persistence of the plume from Shamokin Creek into the Susquehanna River for 3 kilometers from the southern end of

Sunbury, PA. In this reach, the Susquehanna River is bisected by a string of midstream islands that divide it into a west channel and an east channel. We sampled both sides of the east channel at 1 km intervals from the mouth of the creek for the 3 km reach. Also, we sampled above the confluence and in the mouth of the creek. In addition to the biotic samples, we took standard chemical and physical samples at 3 week intervals from the first of September to mid November. We identified diatoms to species using both light and SEM methods. Our results showed that the reduced lateral mixing in the river allowed for a chemically and biologically distinct plume, which behaved as a semi-isolated stream within the river, to persist through the 3 kilometer reach. Particular associations of diatoms differed on either side of the east channel. Species of *Cyclotella* and *Navicula* defined the associations outside of the Shamokin Creek plume, while species of *Nitzschia* defined the diatom associations within the influence of the creek.

Variation in ploidy levels between native and introduced populations of *Phragmites australis* in the Mid-Atlantic region
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It has recently been recognized that both native and introduced populations of *Phragmites australis* coexist in North America. However, little is known about native *Phragmites* and why the two types apparently do not interbreed. We looked at guard cell size and DNA content to test the hypothesis that native and introduced *Phragmites* populations have different ploidy levels, which would prevent them from interbreeding. The native/introduced status of 40 plants was determined using RFLP analysis. Guard cell sizes were measured on all samples (21 native, 19 introduced) and DNA content was estimated using flow cytometry on 13 samples (6 introduced, 7 native). Results of the guard cell analysis indicate that native *Phragmites* plants have significantly larger guard cell areas than introduced plants ($212 \pm 34 \mu\text{m}^2$ vs. $127 \pm 21 \mu\text{m}^2$), indicating that they may have a higher ploidy level. However, flow cytometry found no differences in 2C DNA content large enough to indicate a shift in ploidy level (7.52 ± 0.20 pg vs. 7.24 ± 0.11 pg). In contrast to the guard cell results, this suggests that there is not a difference in ploidy levels between the two population types. It is thus unlikely that incompatibilities due to differing ploidy levels are the reason for the lack of interbreeding. The variation in guard cell size suggests there could be physiological differences between the two population types, possibly facilitating the aggressive invasive behavior of the introduced variety. This is an area needing further research.

Ecological indicators of river health on two tributaries of the Maurice River, NJ
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This project represents a student-initiated study of Parvin Branch and Tarkiln Brook, two tributary streams of the Maurice River in southern New Jersey. These tributaries, located near Vineland, NJ, differ in their surrounding land use patterns. The banks of Tarkiln Brook are urbanized for much of their length, while Parvin Branch is flanked by agricultural land along a large proportion of its length. The lower reaches of the Maurice River are tidally influenced, with brackish water entering from the Delaware Bay. Since June 2003, we have been studying four

sites (two on each tributary) to assess and compare their relative health, as measured by multiple indicators including water temperature, dissolved oxygen, pH, nutrient levels, bacterial counts, algal composition and biomass, and macro-invertebrates. Preliminary assessments indicate that both tributaries are at least moderately impacted by the surrounding land uses, with some differences in indicators between the two. Nutrient levels are higher in the Parvin Branch throughout the seasons covered to date; this pattern is consistent with agricultural uses along this tributary. Algal genera suggest that both tributaries are moderately impaired, with some genera that are indicators of high pollution levels. The macro-invertebrate community is composed of predominately pollution-tolerant organisms in Parvin Branch, and both pollution-tolerant and moderately pollution-tolerant organisms in Tarkiln Brook. The ultimate goal of this project is to improve the water quality of these two tributaries, in conjunction with a local volunteer, non-profit organization whose goal is the preservation and protection of the Maurice River.

The USDA-ARS Farming Systems Project: Evaluating the sustainability of organic and conventional cropping systems in the Mid-Atlantic region

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Organic farming has been proposed as a means of increasing environmental and economic sustainability of cropping systems, but very little data exist on which to base such an assessment. A long-term cropping systems trial was established at the Beltsville Agricultural Research Center, Maryland in 1996 to evaluate the sustainability of three organic systems, one no-till system, and one conventional till system. The three organic systems differ in length of crop rotation. Sustainability of the systems is being evaluated based on agronomic performance, soil quality, nutrient dynamics, soil biological activity and community structure, and economic performance. Results to date show that corn yields tend to be highest in the conventionally tilled system while yields are similar in the no-till system and in the organic system with the longest crop rotation. Among the organic systems, corn yields tend to increase and weed populations tend to decrease with increasing crop rotation length. This corn yield rotation effect seems to be driven more by short-term nitrogen availability and weed population effects than by long-term changes in soil properties. Soil quality, however, does seem to be higher in one of the organic systems than in the no-till and conventional systems. In addition, this same organic system seems to be retaining more N than the other systems. Soil invertebrate communities are different in no-till, conventional and organic systems; the effect of these differences on soil water infiltration is being investigated. Economic analyses are being conducted to provide a more complete picture of overall system sustainability.

A comparison of root respiration rates under hemlock and black birch trees: Will hemlock decline have ecosystem-level effects?

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The invasive hemlock woolly adelgid is currently damaging trees in large regions of the eastern US. As hemlock decline, black birch remain and increase in importance. In the past, a widespread decline in hemlock persisted for ca. 1,000 years and was also associated with an increase in black birch. As a result of current and past changes, there is concern as to how a long-lasting change in species composition may affect important ecosystem functions such as soil respiration. Since roots contribute significantly to soil respiration, this study measured the respiration of roots found under black birch and hemlock trees. Soil cores (10 cm deep) were collected beneath 10 trees of each species. To measure CO₂ production, live roots were removed, washed, placed into closed chambers, and incubated for ~ 45 minutes at 4, 15, 20, and 36°C. Root respiration rates of both species increased significantly with temperature (Q_{10} black birch = 2.17, Q_{10} hemlock = 2.39; $p < 0.001$). However, respiration rates were not significantly different between these species ($p = 0.232$) and the effect of temperature was independent of species ($p = 0.846$). Our results show that a decrease in hemlock and increase in black birch may have little effect on the contribution of roots to total soil respiration. However, hemlock stands have unique microclimates characterized by deep shade and cool temperatures. Given the strong sensitivity we found of root respiration to changes in soil temperature, a decline in hemlock may indirectly increase root respiration by raising soil temperatures.

UV radiation and ephemeral pool food webs

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The diverse organisms that inhabit ephemeral pools vary greatly in their tolerance of Ultraviolet Radiation (UVR). Amphibian populations effectively implement photoprotection and repair processes to minimize the effects of UVR on their ability to reach metamorphosis. Temporary pool invertebrates are more sensitive to UVR than amphibian eggs and larvae. Invertebrate populations differ in tolerance and their reliance upon protection and repair mechanisms. In some systems, seasonal variation in UVR may adversely affect zooplankton and thus indirectly alter the available niches for herbivorous versus carnivorous amphibians.

Leaf litter decomposition on nitrogen-fertilized plots in a temperate deciduous forest

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To examine effects of atmospheric N deposition of litter decomposition, we added leaves to control and N-fertilized plots at the Bousson Experimental Forest in northwest PA. Fertilized plots received nitrogen fertilizer at a rate of 100kg N ha⁻¹yr⁻¹ as NH₄NO₃. In autumn of 2002, leaves were collected from the site and laced into litter bags of black cherry (*Prunus serotina* Ehrh.), sugar maple (*Acer saccharum* Marsh), or a mix of the two leaf types. Ninety litter bags were collected in February 2003 and analyzed for mass, carbon (C), and nitrogen (N) losses. The remaining 90 bags were retrieved in November 2003.

The mean mass loss of litter was similar between treatments, however, loss of C and N varied with treatment and time. Decomposition from February 2003 control and fertilized treatments were not significantly different. Litter bags collected from November 2003, show a loss of carbon (0.0526 g g⁻¹y⁻¹), greater than the loss rate in fertilized plots (0.0464 g g⁻¹y⁻¹). In contrast, N content shows net N immobilization, with lower rates

of immobilization in the fertilized plots (-0.0085 g g⁻¹y⁻¹) than in the control plots (-0.0091 g g⁻¹y⁻¹). These results suggest differential effects of N additions on C and N decomposition dynamics with implication for nutrient availability and forest production.

Sex-differential resistance and tolerance to herbivory in wild strawberry

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We explore the effects of gender dimorphism on resistance and tolerance to a flower bud clipping weevil in a gynodioecious wild strawberry. Using both natural populations and a common garden we document pervasive hermaphrodite-biased damage, and identify several floral traits associated with resistance. Lower flower number and pollen production per flower and earlier flowering date were associated with higher resistance. Because the sex morphs do not differ in flower number or flowering time, the presence of pollen is the main factor determining sex-differential resistance. We confirmed that simulated clipping was a good surrogate for weevil clipping, and used simulated clipping to assess sex morph- and sex function-specific tolerance. We found that females were less tolerant than hermaphrodites in terms of seed and fruit production, but the sex morphs were similarly unable to compensate fully in flower production. Hermaphrodites showed some ability to compensate in pollen/flower, but this was not large enough to offset flower losses, leading to net undercompensation for pollen/plant. We evaluated potential mechanisms for tolerance, and found that the number of reserve buds was the most consistent predictor of tolerance. Finally, we found that herbivory shifted sex expression of hermaphrodites towards greater femaleness via both plastic changes in allocation and direct effects of loss of male-functioning flowers. We discuss the consequences of these aspects of herbivore-plant interaction for floral and sexual system evolution.

Dissolved organic matter may interact with UV radiation to alter zooplankton community structure in a transparent lake

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Dissolved organic matter (DOM) may have a range of effects on lake biota, including ultraviolet radiation (UVR) attenuation and food web stimulation. Our purpose was to determine how an increase in allochthonous DOM in an initially transparent lake may affect zooplankton community structure. We manipulated DOM, UV, and pH in small enclosures containing macrozooplankton at 0.5 m depth for 8 days. DOM generally had a positive effect on survival and reproduction in the presence of UV, but had a negative or no effect in the absence of UV. DOM was more beneficial for *Daphnia* than it was for copepods. Calanoids were especially sensitive to DOM acidity, but benefited from UV attenuation by DOM when it was buffered. Higher *Daphnia* egg production in the presence of DOM and evidence that the DOM was biolabile suggests that DOM stimulated secondary production more favorable to a daphnid diet than a calanoid diet. This study provides evidence that inputs of non-irradiated DOM may be harmful to some zooplankton, and that in some high UV systems an increase in DOM could produce a shift in zooplankton community structure towards daphnids and away from copepods. These results have important ecological

implications, because climate change and anthropogenic effects on certain watersheds may increase DOM inputs to lakes.

Long Island Sound: Diatoms from sediment cores as part of environmental and ecological change studies

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The goal of this research is to document recent environmental and ecological changes in Long Island Sound (LIS) using fossil evidence (diatoms, dinoflagellates and foraminifera) along with biogeochemical evidence such as biogenic silica, metal concentrations, $\delta^{18}\text{O}$, Mg/Ca, and $\delta^{13}\text{C}$ in foraminiferal shells, C_{org} and N_{org} using C and N abundances and isotopic compositions ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$), and changes in sulfur abundances. These proxies are used to re-create the history of eutrophication, hypoxia and anoxia, salinity, temperature and metal pollution in LIS. Sediment cores are also dated using ^{210}Pb and radiocarbon techniques.

Diatom results from two cores collected in southwestern LIS show a decline in diversity and an increase in centric:pennate ratio from the bottom to the top. Diatom species richness in core A4C1 drops significantly after 1800 and declines to a low in 1985 A. D. (of analyzed samples; average of 81 species per sample). Centric:pennate ratios show an increase after 1800 with a peak around 1900. Total diatom abundance shows a peak in productivity in 1900 A. D. Dominant species include *Thalassionema nitzschioides*, *Paralia sulcata* and *Cyclotella* species.

These changes suggest an increase in eutrophication of the basin and possible depletion of dissolved silica in the past century. This conclusion is supported by other data collected. In recent decades, dominant primary producers in LIS may have shifted from diatoms to other phytoplankton such as dinoflagellates, with potential impact on all LIS biota.

Contributions of leaf litter, root litter, and root respiration to total soil respiration in two temperate forests

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Temperate forests soils are sinks for atmospheric carbon. Soil respiration is a large component of the total carbon (C) flux between soils and the atmosphere, however there are large uncertainties in terrestrial C budgets. To better understand processes that alter this flux, we partitioned soil respiration among root respiration, decomposition of aboveground-derived soil organic matter, and decomposition of belowground-derived soil organic matter (SOM). Our sites are located in the productive Allegheny College Bousson Experimental Forest, PA (BF), and the moderately productive Harvard Forest, (MA) Long-Term Ecological Research Site (HF). Partitioning was accomplished at our Detrital Input, Removal, and Transfer (DIRT) treatments by altering inputs to soils from surface leaf litter and preventing root inputs using root barriers. Annual soil respiration was $618 \text{ mg C m}^{-2}\text{y}^{-1}$ at BF and $371 \text{ mg C m}^{-2}\text{y}^{-1}$ at HF. Root respiration accounted for more of total respiration at the less productive HF (33%) than the productive BF (14%), consistent with the hypothesis that forests with more productive soils invest less in root mass. Importantly, we found that 12 years of root exclusion at Bousson has reduced contributions by root litter to total soil respiration. Respiration from belowground litter decomposition declined from 56% of the total in 1991-1992 to

45% in 2001-2002, reflecting the importance of roots in contributing to SOM formation. This study indicates that environmental influences on soil organic matter inputs can strongly influence soil carbon storage.

Stream biomonitoring using macroinvertebrates in the New Jersey Pinelands: Consistency with water chemistry and landuse

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Inconsistencies in the Ambient Biomonitoring Network (AMNET) results versus other indicators of water quality in the NJ Pinelands' blackwater streams have been noted by scientific staff of the NJ Pinelands Commission. Faculty and students of the Environmental Studies Program, Richard Stockton College, are working with New Jersey Department of Environmental Protection (NJDEP), the Pinelands Commission and the Great Egg Harbor River Association to develop revised invertebrate bioassays.

The study areas for this project were several sub-watersheds within the Great Egg Harbor River (GEHR) basin, NJDEP Watershed Management Area #15. In spring 2002, we devised a conceptual model of water quality in the GEHR based on chemical and biological data and percent developed land in each sub-watershed. In summer 2002, we collected macroinvertebrates from diverse substrates and measured pH and specific conductance. Macroinvertebrates were identified in the lab, and multivariate analysis was performed on the data. The percent of developed land seemed to be the best predictor of water quality and biological impairment.

Based on our preliminary analysis, we focused on the macroinvertebrates on woody debris. In June and October 2003, we collected chemical data and additional, replicated samples of 1-2 meters of woody debris, 5-35mm diameter at our sites. There was a clear relationship among stream chemistry, landuse and the fauna on woody debris, indicating that this assemblage is a reasonable target for monitoring. We plan further studies to refine our assay to accurately discriminate among sites showing different degrees and types of impairment, including stream channel alteration.

Species replacement along predator-permanence gradients: Effects of desiccation and fish predation on *Libellula* dragonflies

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Permanence has a major impact on community structure in lentic habitats. Patterns of species replacements along permanence gradients are well documented, but the mechanisms that underlie those replacements are poorly understood for many taxa. The focus of this research was on three congeneric species of dragonflies that occur in ponds and wetlands across most of eastern North America. *Libellula luctuosa* typically occurs in permanent habitats with fish, *L. lydia* typically in both permanent and temporary habitats without fish, and *L. pulchella* in a wide range of habitats from temporary without fish to permanent with fish. In two microcosm experiments, I exposed larvae of all species to 1) different predation threats (green sunfish present vs. absent) and 2) drying regimes (water level maintained vs. moist soil). I found that more *L. luctuosa* survived than *L. pulchella* and *L. lydia* in the presence of fish. When exposed to drying conditions, more *L. pulchella* survived than *L. luctuosa* and *L.*

lydia. My results suggest that *L. luctuosa*'s vulnerability to desiccation could restrict it to permanent habitats. *L. lydia* appears to be vulnerable to both fish predation and drying, and might rely on newly created habitats as a refuge from fish predation. *L. pulchella* is the most desiccation-tolerant, and is probably the only species that can complete its life cycle when habitats dry. These findings suggest that the distribution of the three species along permanence gradients will depend on fundamental (desiccation tolerance) and realized niche (vulnerability to fish predation) constraints.

Tree invasion on reclaimed strip mines: Reevaluating inhibition

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Reclamation of mine-impacted lands often involves grading the land to a relatively smooth contour, and seeding with a grass / legume mix. Preliminary research conducted out of our lab suggested that dense ground cover produced as a result of a successful seeding program may inhibit subsequent woody plant colonization on reclaimed mine sites. As a result, succession to a more native forested ecosystem may be slowed. The purpose of this study was to expand the number of sites examined to determine whether the findings of the previous studies held for other sites. Our findings indicate that tree species that colonize via seed dispersal and seed germination are indeed rare on reclaimed sites with dense ground cover. However, some colonization was noted on dense-groundcover sites by species (particularly black locust) having vegetative reproduction as the primary mode of reproduction. Thus, current reclamation schemes may not inhibit woody colonization, but apparently do restrict the diversity of woody species able to colonize successfully reclaimed sites.

Relationship between tree age and size for the invasive tree-of-heaven (*Ailanthus altissima*)

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Tree-of-heaven (*Ailanthus altissima*) is an aggressive species that can invade natural areas and displace native plant species, and it can thrive in urban settings where it may cause structural property damage. Our goal was to provide park and forest managers with a simple tool for estimating tree age and invasive patterns of tree-of-heaven. To achieve this goal, increment cores were collected at the base and at 1.4 m above ground (breast height) from 39 trees in a population in Westmoreland County, PA. Annual ring measurements from the cores were relativized to diameter at breast height (DBH) and used to quantify the relationship between tree age and DBH. The relationship between tree age and DBH was determined by linear regression analysis. Tree age was more closely related to DBH in relatively young trees than in older trees. As a result of this study, tree-of-heaven age can be estimated by a simple measurement of DBH.

Influence of human and natural disturbances on nesting behavior of bald eagles

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Temporary disruption of the nesting environment represents a significant disturbance in many eagle populations. The goal of this study was to determine whether human activity in the region

posed detrimental influences on the nesting pair of bald eagles (*Haliaeetus leucocephalus*). From a safe distance so that eagles were unaware of my presence, I examined the effects of diverse human and environmental impacts on a pair of eagles along the Allegheny River in northwest PA, along Tionesta Creek. The bald eagles were monitored for responses to various human and natural disturbances over several weeks in May 2003. The study noted 65 total disturbances. Human disturbances accounted for 57 % of the total interruptions observed. Of these human activities, dog barking and boating activity elicited the most response. The most common environmental disturbances included assemblages of ducks and geese moving about at various proximities to the nest site. I found that the eagles showed a response to potential disturbances only 43% of the time, and responses did not appear to differ between human and natural disturbances. Often there was no observable response. Overall, the eagles did not show noteworthy responses to indicate they are detrimentally affected by environmental or human infringement into their immediate breeding area. This illustrates no urgent need to alter management and land use policy in the identifiable bald eagle nesting locale.

Forest stand structure and species composition in a wildlife preserve subject to extreme deer herbivory

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High densities of white-tailed deer (*Odocoileus virginianus* Zimmerman) in the northeastern USA have negative effects on forests. By consuming seeds and small trees, deer inhibit the establishment and growth of trees that might otherwise form the future forest canopy. Previous research in a Pennsylvania wildlife preserve, where hunting is prohibited, has shown the adverse impact of deer on this forest regeneration. We quantified the effect of deer on forest regeneration by censusing trees at six locations in the preserve (total plot area = 0.96 hectares). Compared to a nearby, ecologically-similar forest where deer hunting is permitted (studied previously), the mean density of trees 30 cm tall - 9.9 cm dbh (diameter at breast height) in the wildlife preserve was markedly lower: 840 stems/ha vs. 5300 stems/ha. The difference between our study locations and the comparison forest is greater if we consider only tree taxa that are capable of growing large enough to be part of the forest canopy. At our six locations, the mean density of these trees in the 30 cm tall - 9.9 cm dbh size class was 230 stems/ha vs. 5100 stems/ha in the comparison forest. At four of our locations, we found no trees in the 30-129 cm tall size class that are capable of joining the forest canopy. The results indicate that the inhibition of forest regeneration at the wildlife preserve is widespread. The results also support previous research at the wildlife preserve indicating that as large trees die, they are not being replaced in the forest canopy.

June bugs invade links: Pesticide use reduction with geographic information systems

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At the Ruggles Golf Course, located on the U.S. Army Aberdeen Proving Ground, Maryland, the beetle larvae had become more than just a minor pest problem. The larvae of the green June beetle had infested the fairways, greens, and the driving range, leaving mounds of dirt from their holes and severely damaging the turf. The golf course staff had repeatedly applied insecticides to the entire course with little long-term success, as well as hindering progress toward U.S. Army pesticide use reduction goals. As an innovative solution, the Entomological Sciences Program of the U.S. Army Center for Health Promotion and Preventative Medicine used geographical information system (GIS) technology to precisely target the use of pesticides against green June beetle larvae. By geo-referencing areas of the course that were infested with the beetle larvae, they were able to treat only those specific areas with targeted pesticides, instead of conducting a broad application of pesticides over the entire course. This technique eliminated the green June bug problem and reduced pesticide use by 80% per year at the golf course. This technology is applicable to golf courses, parks, sports fields, firing ranges, and other places with turfgrass. It can reduce pesticide use by 80%, reduce applications costs by 50%, and reduce worker and user exposure to chemicals.

Nutrient effects on phytoplankton and metaphyton in shallow ponds

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We studied seasonal variation in the abundance of phytoplankton and metaphyton (floating scums of filamentous algae) in relation to nutrient concentration in 13 ponds in Chester County, PA during March, May and July of 2002. Seven of the ponds had primarily residential watersheds, and 6 were farm ponds. The ponds were all eutrophic or hypereutrophic based on Carlson's Trophic State Index, but varied widely in nutrient content (from 16-350 µg total P/L and from 518-5700 µg total N/L), size (from 0.1 – 1.7 ha) and management history. Total N typically declined, while total P rose, from March to July. Phytoplankton biomass (as chlorophyll-a) was closely related to total P and strongly determined light penetration and stratification. The submersed invasive aquatic plant *Potamogeton crispus*, abundant in two of the ponds, appeared to suppress phytoplankton growth during early spring but may have served as a growth stimulant when it decomposed and released stored nutrients in late June. Metaphyton biomass in individual ponds was typically greatest in July, was less predictably related to nutrient concentration in the water column, and was usually dominated by 1-3 genera of filamentous green algae. This study emphasizes the unique problems introduced by nutrient loading in small ponds compared with larger lakes.

Carbon gain in seedlings of Eastern Deciduous Forest

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Although positive carbon gain is necessary for plant survival in the understory, few studies have compared carbon gain for different functional groups growing in the same habitat. We hypothesized that there would be no detectable difference between carbon gain of seedlings of woody species that remain in the understory and seedling of canopy trees. We used dynamic measurements of photosynthesis to parameterize a model of carbon gain for red oak (*Quercus rubra*), chestnut oak (*Quercus prinus*), beech (*Fagus grandifolia*), witch hazel (*Hamamelis virginiana*), viburnum (*Viburnum acerifolium*), and junberry (*Amelanchier* spp.). Measurements of photosynthetic photon flux density were used to drive the model to provide estimates of daily carbon gain in the understory of the Lacawac Sanctuary in Northeastern Pennsylvania.

Effects of ultraviolet radiation on zooplankton: Behavioral and population responses

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Increased exposure to ultraviolet radiation (UV) can be an important stressor in aquatic ecosystems. The objective of this study was to expand the spatial and temporal scale of previous experiments examining the effects of UV radiation on freshwater zooplankton. We conducted an *in situ* mesocosm experiment in highly UV transparent Lake Giles, Pennsylvania, in which we imposed two treatments: ambient UV and UV-shielded. Mesocosms (0.8 m diameter, 8 m deep) were large enough to include a spatial refuge from UV and allow natural patterns of diel vertical migration. In addition, the four week duration of the experiment was sufficient to include complex indirect effects mediated by food web interactions. *Daphnia catawba* migrated into the UV refuge at the bottom of the mesocosms in the presence of UV, but was found distributed throughout the mesocosms in the UV-shield treatment. In contrast, *Diaptomus minutus* was most abundant in the deeper parts of the mesocosms regardless of the presence/absence of UV. For both *Daphnia catawba* and *Diaptomus minutus*, population abundance was significantly greater in the ambient UV treatment than in the UV-shielded treatment. Because both of these species have been reported to be UV sensitive, this counterintuitive result underscores the importance of food web interactions in determining community responses to UV.

An ecological assessment of coarse woody debris volume and wildlife use in Virginia

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Coarse woody debris (CWD) is an important component of forested ecosystems. Snags (standing dead trees) and logs provide feeding sites, nesting cavities, shelter from predators, and hibernation dens for small mammals and birds; provide a moist habitat for reptiles and amphibians; and serve as a growing medium for various plants. Coarse woody debris plays an important role in nutrient cycling through decomposition and can promote soil and slope stability by reducing rates of run-off and erosion. The objectives of this study were to: (1) quantify the relationship between forest cover type and CWD volume and (2) correlate CWD volume with small mammal and bird activity. Volume and wildlife use of CWD were assessed within 12

mature, second-growth forest stands in Virginia. Four stands were sampled within each of three major forest cover types. Cover types and associated Virginia physiographic provinces included the oak-hickory (Blue Ridge/Ridge and Valley), oak-pine (Piedmont), and pine-hardwood (Coastal Plain) forest types. Within each stand, the volume of CWD was measured in six, randomly located 0.1 ha plots. Small mammal and bird activity was assessed by quantifying use evidence (bodily, foraging, and movement). Forest composition and structure were also sampled by recording species and diameter of all trees in a 0.03 ha plot nested within the larger CWD plot. Volume of CWD decreased from west to east across Virginia. However, wildlife use showed no spatial patterns. The results of this study have implications for natural resource managers attempting to integrate wildlife management into traditional forest management practices.

Preliminary results of residential lawn care survey near the Cub Hill flux tower

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Residents in a suburban neighborhood of Baltimore County were surveyed about their lawn care practices. The focus of our survey was to examine lawn care practices and determine how land management practices affect water quality and soil characteristics. The survey found that 80% of residents do not use a lawn care service. Among the residents who use lawn care services (20%), fertilizer is used by approximately 63% with 82% using a dry fertilizer, 4% using a liquid and 14% using some combination of the two. Herbicide, pesticide, and lime were applied by 40%, 33% and 16% of the respondents, respectively. Approximately 78% of the residents use a gas powered mower, 16% use a riding mower, 4% use an electric mower and only 1% use a manual/push mower.

In addition we assessed the effect of lawn care management/practice on soil characteristics. A total of 60 soil samples were collected from the respondent's houses. Six replicate bulk density samples were collected from each house, three from the front and three from the back. The bulk density of the front of the house (1.37±0.025, N = 31) was slightly lower compared to the back (1.40±0.026, N = 29), though these differences were not significant. Also, 30 year old yards had a lower bulk density (1.379±0.031, N = 9) than 20 year old yards (1.436±0.04, N = 7). These results suggest there is no effect of lawn care management on soil bulk density in this suburban neighborhood.

Escape behavior of neotropical homopterans in response to a flush-pursuit predator: The importance of primary defenses

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Insect defenses against avian predators often include a primary defense that reduces the probability of being attacked, and escape behavior (e.g., a secondary defense) if the primary defense fails. Escape behavior can make insects vulnerable to specialized flush-pursuit predators. Neotropical redstarts of the genus *Myioborus* (Parulidae) exploit insect escape behavior by using contrasting

black-and-white plumage and animated foraging behavior to startle prey that are pursued and captured in flight. I examined how insect primary defense strategy and natural variation in *Myioborus* plumage pattern influence escape behavior in six species of homopterans from Monteverde, Costa Rica. The homopterans included two aposematic species of the family Cercopidae (*Ocoaxo* sp. and *Sphenorhina* sp.), two cryptic species of the family Cixiidae (both *Bothriocera* spp.) and two structurally defended species of the family Membracidae (*Campylocentrus* sp. and *Vestistilus variabilis*). I measured the distance at which models of *Myioborus* redstarts elicited insect escape behavior under field conditions. Response distances varied significantly with both homopteran primary defense and *Myioborus* plumage pattern. Structurally defended homopterans were most sensitive to the models and cryptic homopterans were least sensitive. The model simulating plumage of endemic *M. miniatus comptus* of Costa Rica elicited greater responses than models of other *Myioborus* taxa with either less or more white plumage. My results suggest (1) primary defense strategies can have a significant affect on insect vulnerability to flush-pursuit predators, and (2) geographic variation in the plumage pattern of *Myioborus* redstarts may reflect adaptation to regional prey and habitat characteristics that maximizes flush-pursuit foraging performance.

Nonlinear responses of *Alliaria petiolata* to environmental quality throughout plant life history

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Information about how plants respond to resources in their environment enables us to understand patterns of population growth. This is especially important for understanding the behavior of exotic invasive species. In 42 study plots, we observed growth, survival and fecundity of invasive *Alliaria petiolata* (garlic mustard) along with the abiotic factors of light, water, and Nitrogen availability to see how the plants respond to environmental variation. In medium range water availability, seed production is maximized. Percent light and cover have contrasting influences on plant survival. While increased light increased plant survival, increased ground cover decreased survival. Increased NH₄ availability has a negative relationship with plant chlorophyll. These nonlinear responses vary throughout the life cycle of *A. petiolata* and further investigation of the complexity of the plant's relationship with the environment will be helpful in developing control strategies that are ecologically sensitive.

Natural and human-mediated dispersal of zebra mussel from Eaton Brook Reservoir, Madison County, NY

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Aquatic nuisance species often threaten ecological function, and thus the sustainability of native population's co-occurring in invaded habitats. Among the most problematic aquatic nuisance species is the zebra mussel (*Dreissena polymorpha*). The first established population of zebra mussels in the Upper Susquehanna River Basin (USRB) is in Eaton Brook Reservoir (EBR), Madison County, New York. This small impoundment may serve as a source population for further dispersal of zebra mussels in the USRB by natural and human-mediated means. The goal of this project was to examine boater habits to

determine where the mussels came from and to predict where future dispersal may occur. Boater habits were determined by interviewing boaters in the summer 2003 using a randomly designed boater survey. Additionally, natural dispersal via drift from the EBR's outlet stream was examined by bucketing known volumes of water through a 63 μ m-mesh plankton net at fixed locations below the outlet and quantifying veliger concentrations using cross-polarization microscopy. An estimated 98 boaters may have transported live adult zebra mussels from EBR to other water bodies during the summer months of 2003. Although humans are likely the sole vectors of zebra mussel dispersal from lake to lake, veligers were passively transported through Eaton Brook (~25km) to the Chenango River, a tributary of the Susquehanna River, for several weeks during the summer 2003. The mean summer veliger concentrations were 8.47 ± 6.26 and 0.10 ± 0.07 veligers/liter (± 1 SE) for EBR and Eaton Brook's junction with the Chenango River, respectively.

Nitrogen balance in organic and conventional cropping systems in the Mid-Atlantic region

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One of the goals of sustainable agriculture is to maximize nutrient retention and minimize off-farm environmental costs. As part of an assessment of system sustainability, we compared nitrogen inputs and outputs during a 5-year period for six cropping systems at the USDA-ARS Farming Systems Project in Beltsville, MD. The systems, which included corn (C), soybean (S) and wheat (W) crops, were designed to mimic systems used by area farmers and/or to reduce inputs. Two cropping systems were managed according to National Organic Program standards: one was a 2-year C-S rotation; the other was a 3-year C-S-W rotation. Both rely on rye and legume cover crops and the 3-year rotation also includes poultry litter (PL) inputs. The other four systems were 2-year C-W-S rotations managed using conventional fertilizers and herbicides. One system is managed using no-till (NT) methods; the other three use conventional tillage methods and mineral fertilizers only (CT-MF), MF and PL (CT-PL), or MF and composted PL (CT-CPL). Nitrogen inputs were greater than N outputs for the C phase of all rotations and for the S phase of the 3-year rotation. Nitrogen inputs were less than N outputs during the W-S phase of the 2-year rotations. After 5 years, the CT-PL and the 3-year organic systems retained N (N inputs > N outputs), the no-till system had a net loss of N, and the other three systems showed no significant net N losses or gains. These results suggest that systems that include PL may retain more N than similar systems that do not use PL.

Light-treatment-dependent phenotypes of *Chenopodium album*

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In an experiment to examine the role of nighttime water loss, we observed two distinct forms of *Chenopodium album*, exemplified by a bimodal height distribution. Although all plants were exposed to red/far red light (about 750-800 nm) during the

overnight period, about half the plants displayed a shorter bushy phenotype, similar to plants in their natural environment, while the other half were taller and less branched, a typical shade response. In a separate experiment designed to quantify differences between these phenotypes, in which we did not expose plants to red/far red light, we failed to observe these differences and plant height was normally distributed. We thus conclude that the expression of these two phenotypes is dependent upon the presence of red/far red light, as might be expected if it is related to shade response. *Chenopodium album* normally grows in high light, non-shaded environments. However, the presence of two phenotypes that occur in response to red/far red light may indicate genetic differences that would impact fitness of plants growing in sub-optimal light conditions including situations where plants are shaded by competitors. We propose potential mechanisms and discuss the possible benefits of light-induced phenotypes and ways to test these ideas.

The influence of predator mating status on chemically-mediated antipredator responses in the wolf spider *Pardosa milvina*

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The wolf spider, *Pardosa milvina* exhibits effective defensive responses (reduced activity) in the presence of chemical cues (silk and excreta) from the co-occurring larger wolf spider *Hogna helluo*. Adult female wolf spiders vary considerably in their propensity to feed based on their age, mating status, and reproductive state. After mating, but before egg sac production, female lycosids become much more voracious and often double their body weight in preparation for producing a large egg sac. Also, silk-bound sex-pheromone production by females is high prior to mating, but decreases quickly after mating. We hypothesized that *Pardosa* may benefit by discriminating between chemical cues from a mated vs. unmated female *Hogna*, and exhibit defensive behaviors proportional to the level of risk. Using an automated video-tracking system (Noldus Ethovision), we measured *Pardosa* activity levels in the presence of silk and excreta from an adult female *Hogna* under four different mating treatments (N = 17/21/treatment): 1) *Hogna* cues from a female that was unmated, 2) cues from a female with one-insertion from a male during copulation, 3) cues from a female with two insertions, and 4) cues from a female that received a full mating. *Pardosa* activity level across these treatments was also compared to a control substrate lacking predator cues. *Pardosa* behavior was significantly lower on most substrates containing *Hogna* cues relative to the control substrate. Preliminary analysis shows that there are also significant differences in some measures of activity on substrates with mated predator cues compared to unmated predators.

The influence of predator reproductive state on chemically-mediated antipredator behavior and survival in the wolf spider *Hogna helluo*.

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The wolf spider, *Pardosa milvina*, preys on spiderlings of another species of wolf spider, *Hogna helluo*. Wolf spiders are known to show defensive behavior in the presence of silk draglines and excreta from predatory wolf spiders; however, depending on their reproductive state, adult female wolf spiders may vary in the production of these cues as well as their proclivity to attack prey. After maturity females may double their body weight in preparation for producing a heavy and energetically costly eggsac

that they then attach to their spinnerets. After egg production, females may decrease prey consumption which would decrease excreta production and eggsac carrying may reduce silk production. We tested three hypotheses: 1) females with eggsacs are less dangerous predators than females without eggsacs, 2) *Hogna* spiderlings will show greater antipredator behavior in the presence of silk and excreta from a female without an eggsac than with an eggsac, 3) *Hogna* spiderlings will show differential survival among live *Pardosa* females depending on the source of the silk and excreta available (from an eggsac-carrying female or one without an eggsac). Adult females without eggsacs were more dangerous predators and *Hogna* spiderlings reduced activity in the presence of silk and excreta from *Pardosa*.

Natural or chemical control: A comparison of the salinity and glyphosate treatment of Japanese Barberry (*Berberis thunbergii* DC)

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The goal of this project was to assess foliar salt-sprays (NaCl) as a potential control method for Japanese barberry (*Berberis thunbergii*), an exotic, invasive plant species. Effects of foliar salt-sprays of varying concentrations (0.0, 0.3, 1.0, 3.0%) were compared to those of a glyphosate-based herbicide over a four week treatment period during the summer of 2003. Health of barberry seedlings was evaluated each week by estimating foliar discoloration and foliar density. At the end of the treatment period, each plant was rated as healthy, moderately healthy, moderately unhealthy, or unhealthy. Barberry seedlings were negatively affected by salt-spray in early weeks of treatment, but salt-sprays had no significant effect on foliar condition by the end of the treatment period. Further experimentation will be conducted using higher concentrations of salt-sprays and the use of corn oil as simulated surfactant.

Quantifying acorn removal by seed predators in a wildlife preserve, south-central Pennsylvania

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White-tailed deer (*Odocoileus virginianus* Zimmerman) inhibit forest regeneration where their population densities are high. Previous studies in a wildlife preserve, where deer hunting is prohibited, indicate that deer have nearly eliminated the small trees. To begin determining the relative contribution of seed predation and post-germination herbivory to the lack of small oaks (*Quercus* L.) in the preserve, we are experimentally determining acorn removal rates. Our three treatments are (1) protection from deer and rodents (wood and wire-mesh enclosures, 1.3 cm square openings), (2) protection from deer (identical enclosures with added 8.9 cm round openings), and (3) no protection (acorns on the ground). At each of three locations, the treatments are replicated three times and with acorns of two species: white oak (*Q. alba* L.) and red oak (*Q. rubra* L.). We hypothesize that deer are the major acorn predator so removal rates for unprotected acorns will be greater than for those protected only from deer. For white oak acorns, initial results indicate that seed predation rates for unprotected acorns are double those for acorns protected only from deer (0.052/day vs. 0.025/day). For red oak acorns, seed predation rates for unprotected acorns are triple those for acorns protected only from deer (0.034/day vs. 0.010/day). We recognize that black bears

(*Ursus americanus*) and turkeys (*Meleagris gallopavo*) may be consuming unprotected acorns along with deer. Our experiments will continue through the winter.

Duff moisture in thinned black spruce stands and related changes in predicted fire behavior

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Fire is a critical disturbance that maintains boreal ecosystems. Black spruce (*Picea mariana*) trees are very flammable and have high crowning potential. Stands are often thinned creating a firebreak around towns and villages. The concern is how thinning alters the moisture content of ground fuels (moss and duff layers) and the impact on predicted fire behavior. Duff samples were taken from thinned (10 x 10 ft spacing) and control sites in three sites in interior Alaska. Moisture content in live moss, dead moss, and upper duff fuel layers was measured with Campbell Scientific DMM-600 time domain reflectometer. Live moss in thinned stands was approximately 60–70% drier than moss from control sites, while dead moss ranged from 35-70% drier in two out of three sites. The fuel codes used to predict fire characteristics were substantially higher in thinned areas. The Duff Moisture Code estimated by Remote Automated Weather Stations was approximately 50% higher than the measured values. Thinned tree stands have different moisture dynamics that are not consistently illustrated by the current fire prediction models and could critically impact fire management and response decisions.

Effect of urbanization on water quality of Molly Ann Brook, Passaic County, New Jersey

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Molly Ann Brook is a small tributary to the Passaic River. The stream has two distinct sections, which we have called Upper Molly Ann Brook and Lower Molly Ann Brook. Upper flows through upscale neighborhoods in North Haledon and Haledon, whereas the Lower flows through highly urbanized Prospect Park, Haledon and Paterson before it enters the Passaic River adjacent to Kennedy High School. The Lower section has also been channelized for flood control on recommendation of the U.S. Army Corps of Engineers. Our objective was to measure the water quality of the Lower section by sampling macroinvertebrates and fish and to compare the water quality to the Upper area. The same kind of ecological data had previously been collected in the Upper section. Our results confirm our hypothesis that the intense urban land use in the Paterson City area has decreased the water quality of Lower Molly Ann Brook. The diversity and density of key types of macroinvertebrates and fish were substantially reduced in the Lower section compared to those in the Upper section of the stream. Based on our results, the water quality of Lower Molly Ann Brook has been degraded by urban land use.

Relative contributions of fish hatchery carbon to sediments and pollution tolerant isopods in limestone-influenced streams of Cumberland County, Pennsylvania.

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Some limestone spring creeks in Pennsylvania have been impaired by nutrient and organic inputs, indicated by pollution tolerant isopods (*Lirceus*) and sedimentation. We estimated contribution of hatchery carbon to fine sediments and to *Lirceus*

in Big Spring, an ecosystem that formerly received hatchery effluent, and to other Cumberland Valley streams with hatcheries. Using natural abundance ^{13}C , we estimated that 80-84 % of carbon in Big Spring sediments following hatchery closure was hatchery derived. *Lirceus* diet in upper Big Spring was 76% hatchery waste one month following closure (Dec. 2001), and 10% in July 2002. Further downstream, *Lirceus* was deriving 69-76% C from C3 plants or agricultural waste. March 2003 sampling revealed an increase from July 2002 in the percentage of hatchery-derived carbon in sediments in Big Spring and Green Spring, a similar ecosystem with a hatchery at its source. However, *Lirceus* in both spring creeks were reflecting a C3 plant/agricultural waste diet at this time. Hatchery waste contributed 77% and 67% to *Lirceus* C downstream of hatchery outfall on the Yellow Breeches (a large order stream with limestone spring influence) in July 2002 and March 2003, respectively. The hatchery signature remained present far downstream, where 22% of sediment and 39% of *Lirceus* C was hatchery derived. Hatchery waste in sediment C was 100% in upper Green Spring and 80 % downstream in March 2003, and continued to be abundant (>50%) in Big Spring sediments, suggesting stronger and lasting impacts of hatchery waste on low-gradient spring creek systems.

An explanation of patterns of breeding bird species richness and density following clearcutting in Northeastern U.S.A. forests

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We surveyed breeding birds for an average of 4 yrs on 23 primarily even-aged successional stands ranging from 2 to 120 yrs-old to observe changes in species richness and density following clearcutting in central New York. An initial sharp increase in richness and density from post-cut yrs 2 to 6 preceded a steep decline by yr 25. Cubic functions best fit this ($P < 0.0007$) and a second, smaller increase and decline in richness and density between yrs 25 and 120 ($P < 0.03$). The rapid initial increases in richness and density were highly correlated with leaf area which, on plots that were heavily stocked prior to cutting, returned to pre-cut levels by yr 6 or 7. Species richness on 6 yr-old clearcuts was more than twice that of any mature stand sampled. Similarly, 6 yr-old clearcuts exhibited a mean avian density (501 pr/40ha), more than 2.5 times that of any mature stand (184 pr/40ha). The decline in avian populations from yrs 7 to 25 accompanied canopy closure and was likely associated with the loss of foraging and nesting sites near ground level. The second, less pronounced increase in avian richness and density from yrs 25 to 100 was associated with 1) the redistribution of foliage to all vertical layers of the forest resulting from the increasing size and duration of canopy gaps caused by tree deaths; and 2) the increasing size and bark complexity of tree boles, which provided new foraging and nesting substrates. Overall, avian successional trends appear to be determined by the development and decline of vegetation patch types appropriate to specific guilds of birds. We suggest that, while lacking the vertical heterogeneity and bole-related substrates traditionally cited as correlates of avian richness and density in older forests, early successional stages of northeastern forests support significantly higher avifaunal richness and density due to a combination of high productivity of leaves and insects along with increased horizontal structural complexity. Even-aged stand management, carefully

implemented through clearcutting, has the potential to increase the species richness of forested landscapes and provide important habitat for early successional Neotropical migrants, while effectively meeting demands for marketable timber.

New ways to use "Wisconsin Fast Plants" (rapid cycling *Brassica rapa*) in ecological research and instruction

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The National Science Foundation has long supported the use of "Wisconsin Fast Plants" (rapid cycling *Brassica rapa*) in the teaching of Biology (K-12). In spite of this exemplary effort to create investigative student experiences across grade levels, one area that is significantly lacking is the development of ecological investigations using Fast Plants. In this poster I show how I have incorporated Fast Plants into my research and instruction. This permits me to provide students with:

- An authentic & enriching research experience
- A link between "classroom" & "professional practice"
- A connection between what students read & reality
- Experience with "Fast Plants" as a model system for research & teaching.

I will also provide practical information about my experiences growing Fast Plants in the field as well as summarizing similar college-level investigations done by others.

Analysis of nitrate and potential flowpaths within a system of karstic spring creeks in Cumberland County PA

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Karstic groundwater systems underlie fertile agricultural land and give rise to productive spring creeks in the Cumberland Valley of PA. Elevated nitrate within the hypothesized regional flow system of spring creeks in Cumberland County, PA could be a threat to fish and aquatic invertebrates and drinking water quality. On a larger scale, this flow system may further degenerate already nitrogen-saturated waters of the Chesapeake watershed. Flow systems of the springs begin within quartzite and schist layers of South Mountain. Water is lost to carbonate rock formations down-slope in a separate surface watershed, and then discharges mid-valley. Because agriculture and development characterize the region and runoff rapidly infiltrates the fractured karst, NO_3^- - N discharges at high rates (e.g. 9285 - 14805 kg/month at Big Spring during the dormant season). Of special consideration is how nitrate is picked up during karst residence, which necessitates understanding the extent of the regional flow system rather than focusing on riparian buffers etc. along the channels. Nitrate concentration in Big Spring source can be nine times greater than South Mountain tributaries (7.1 mg/L v. 0.8 mg/L upon last observation). This study will estimate nitrate flux in larger spring creeks of the valley (Big Spring, Green Spring, Mt. Rock Spring, Letort Spring), and flowpath and residence dynamics that could affect the patterns of nitrogen pollution in the watershed.

Species richness, abundance and composition of ground-dwelling ants in northern California grasslands: the role of plants, soil, grazing, and dominant species

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We examined the effect of soil composition, plant community, and grazing on ant species richness and abundance in northern

California grasslands. Worker ants were gathered using pitfall traps at 109 sites in the McLaughlin Reserve over a two-week period in May 2003. We collected a total of 719 ants from 83 sites (26 traps contained no ants). We identified 18 ant species, but the majority of the ants belonged to three species: *Messor andrei*, *Pheidole californica*, and *Solenopsis xyloni*. Soil characteristics explained most of the variation in both ant richness and abundance. Plant characteristics, such as biomass, weakly correlated to ant abundance, and grazing had both positive and negative associations with the three dominant species and with all ants combined. We also discuss relationships among the three dominant ant species.

Photomonitoring ecological change in Northwest Yunnan, PRC

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The use of historical repeat photography provides valuable information on temporal changes in terrestrial landscapes. Most of these studies, however, are opportunistic in that they have had to rely on obtaining old photographs of areas of concern to natural resource managers and/or conservationists (e.g., Greater Yellowstone). Hence, the interpretative power of such studies is greatly limited by the intention of the original photographer, as well as by camera and film technology and the quality of the original photos. A current project by The Nature Conservancy (TNC) is examining the potential use of repeat photography to assess ecological changes across the Hengduan Mountains and the Nujiang-Lancang Gorge Ecoregions in Northwest Yunnan as part of their conservation planning efforts in China. A ground-based, photomonitoring methodology has been developed and tested along transects across these two adjacent ecoregions. Furthermore, visual indicators obtainable from the resulting photographs have been identified to assess the threat status (e.g., climate change, logging, grazing) for vegetative conservation targets (e.g., evergreen broadleaf forest, mixed forest, alpine mosaic) as part of TNC's efforts to monitor the impacts of their conservation programs across geographically extensive and diverse ecoregions. Preliminary results from this project will be presented.

Small-scale resource movement by animal consumers

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Resources such as nutrients and energy can be moved across space by abiotic forces (i.e. wind and stream), as well as biotic factors (i.e. animal movement). In many cases, animals do not carry resources in a physically obvious way. For example, animals may consume resources in one place and then move to another place. Therefore, quantitative evaluation of the mode and magnitude of resource movement by animal consumers presents a challenge to ecologists. In order to trace how animal consumers move resources across space, we did a masting simulation experiment using isotopic tracing techniques. Millet seeds were added to field sites in the fall of 2003 at Blandy Experimental Farm. Millets seeds carry distinct stable carbon and nitrogen signals that are different from background plant signals. We focused on a generalist species, *Peromyscus leucopus*, and traced them repeatedly throughout the experiment. Upon consumption of millet seeds, isotopic ratios of mice tissues will gradually shift from background signals to millet signals. The results showed

that: (1) millets seeds might have been moved across space by foragers that commute between their home ranges and masting sites; (2) mean fractionation of mice diet derived from millet seeds is equal between food-supplemented grids and control grids. Our study suggests that resources can be effectively transfer upwards in local as well as neighboring food webs by resident and commuter foragers, and isotopic tracing can be a promising tool in studying small-scale resource movement by animal consumers.

Effect of population size on insect visitation of *Gentianopsis crinita* (Frole.) Ma. (fringed gentian)

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Habitat fragmentation results in the isolation of fringed gentians in small and large populations. Individuals in small populations (1 to 6 plants) had low seed germination rates compared to those in larger populations (10 to 50 plants). We hypothesized that low pollinator visitation results in a lack of effective pollination. By observing individual flowers for 10-min intervals and recording the class of insect and duration of visitation, we compared two small populations and two large populations. A total of 34 observation periods on three separate dates were made during a three-week period. There were no differences between population sizes with respect to the frequency of visitation (33.3 vs. 31.3%, large vs. small) or the average visitation time (249 vs. 234 s). The small population had a larger proportion of visitation by Hymenoptera (100%) while the large population had visitation by Coleoptera (50%), Homoptera (17%), and Hymenoptera (33%). These results do not support the hypothesis of differential pollinator visitation to populations of different size to account for seed germination patterns.

Spotted Turtle (*Clemmys guttata*) movement and habitat use in a heavily managed area of Michaux State Forest, Pennsylvania

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Ten spotted turtles, *Clemmys guttata*, were radio-tracked in a heavily managed area of Michaux state forest, Pennsylvania in 2002 and 2003. Use of clear-cut and forested habitats along with seasonal movements were assessed in relation to the current Pennsylvania Bureau of Forestry wetland buffer regulations. Turtles were found to travel outside of the 30-meter no cut and 60-meter buffer partial cut zones to nest and to travel between vernal ponds. Extensive use of upland habitats from April to October was documented in both years. Turtles traveled considerable distances throughout the study and all turtles hibernated in the same one pond both years. Habitat use and seasonal movement varied between years, probably as a result of differences in weather. Based on the results of this study, two recommendations are provided regarding timber harvest and protection of spotted turtles. The first recommendation is to limit timber harvest to the months of November through February, thereby avoiding the active season of spotted turtles. The second recommendation is to extend the Pennsylvania Bureau of Forestry no cut buffer to 60-meters, to protect estivating turtles and turtles traveling between ponds. The preferred option would be to combine both recommendations to have a 60-meter buffer and restrict logging to between November and February. Finally, this study demonstrates the importance of multi-year studies to

identify all critical habitats of spotted turtles so that they can be better protected.

Butter-butts and candle berries: a case of reciprocal specialization

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Specialization between fruiting plants and frugivores is rare and usually asymmetrical when it does occur. Anecdotal evidence and recent research suggest that the relationship between yellow-rumped warblers (*Dendroica coronata coronata*) and wax myrtle (*Myrica cerifera*) may be an exception to this trend. To test the degree of relative specialization, I recorded both fruit use by yellow-rumped warblers and the identity of dispersers of wax myrtle and also measured the effect that decreasing numbers of each participant had on the other. Three years of fecal data collected on Assateague Island National Seashore revealed that fruit use by yellow-rumped warblers is confined almost exclusively to wax myrtle during the warbler's 7 month residence (October-April) with no sign of intra- or interannual variation. Yellow-rumped warblers were also the most constant and numerous disperser of wax myrtle seeds and the only disperser present throughout the fruiting season (October-April). Census data indicated that, in each of the three years examined, yellow-rumped warbler abundance was significantly influenced by wax myrtle fruit abundance. Similarly, the numbers of wax myrtle seeds was significantly related to yellow-rumped warbler abundance. I suggest that the reciprocal specialization between yellow-rumped warblers and wax myrtle observed on Assateague Island is not just a local phenomenon.

The effects of development on water quality in Hilton Run subwatershed

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Hilton Run is a small stream in the middle of St. Mary's River (Maryland) Watershed. The 2,102-acre Hilton Run subwatershed comprises only 4% of the total St. Mary's River watershed. Hilton Run's headwaters are in Lexington Park, an area experiencing high development pressure. Another problem in the subwatershed is the recent clearing of 500-600 acres of forest near the stream's middle reaches. As residential and commercial development increases, the integrity of the aquatic ecosystem becomes compromised due to increased imperviousness, runoff, and erosion, which degrade biotic diversity. The objective of this study was to determine how urbanization and development within a subwatershed impact stream discharge during storm events and water quality. Although most of the Lexington Park development is near the headwaters of Hilton Run, all reaches are impacted by the impervious surfaces due to cumulative flow and export downstream. The greatest change in discharge volume is expected in the headwaters since this area is closest to high imperviousness and increased runoff. The lowest change in discharge is expected in Hilton Run's middle reaches where there is a flood plain; however, the clear-cut located in this area will have some impact. Nutrients including nitrogen and phosphorus are predicted to be higher at the upper reach since there is more input from runoff and less time for infiltration into the soil. Storm events show a greater correlation between discharge, nutrient levels, and imperviousness since runoff is a major component during these events. These results can be applied to the St. Mary's River watershed as a whole and used to formulate management plans to improve water quality.

Comparison study of fecundity and size between urban and rural Black Nosed Dace (*Rhinichthys atratulus*) populations MC AFEE, E. M. and J. SNODGRASS. Towson University, Biology Department, 8000 York Road, Towson, MD. 21252 USA

Evolutionary theory suggest that when faced with decreased adult survival rates organisms may adapt by allocating more energy to reproduction at an earlier age. Organisms persisting in urban environments are expected to have higher adult mortality rates and it has been reported that black nosed dace (*Rhinichthys atratulus*) from urbanized watersheds tend to have decreased age and size at maturity when compared to populations in more rural watersheds (Franker, et al. 2002). Based on these results we investigated the relationship between size and fecundity among dace from urbanized and rural watersheds. Histograms of egg diameter indicated that a single clutch of eggs could be identified in each female examined. An ANCOVA model indicated a significant difference ($P = 0.002$) in the intercepts of lines relating clutch size to standard length between females from urbanized and rural watersheds. There was no difference in slope for these lines ($P = 0.257$). Our results suggest that dace from urbanized watersheds allocate more energy to reproduction. However, because other studies have found increased growth among dace from urbanized watersheds, it remains unclear whether dace in urbanized watersheds have adapted to increased adult mortality or are just responding to increased resources levels in the urban environment.

Fire management effects on vegetation in the New Jersey Pine Plains at Warren Grove Air National Guard Range

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The effects of fire management on plant community structure in the East Plains of the New Jersey Pine Barrens are poorly understood. The East Plains support a globally rare dwarf pine plains community that is thought to be influenced by a high frequency of warm season wildfires. Warren Grove Range has used winter prescribed burning to reduce hazardous fuel loads since 1985; however, it is not clear if winter prescribed burns have the same effect on the plant community as warm season wildfires.

To determine the effects of the fire management program on the pine plains community at Warren Grove Range, we divided the site into a series of fire categories based on the last fire event: 2002, 1998, 1999, 1959, two wildfires (1999 and 2000) and a reference site off-Range (wildfire 1972). We constructed 10 permanent plots (10 m²) in each fire category. In each plot, we identified all plants, tallied the number of pine and oak trees, measured canopy diameter of trees and measured the tree basal diameter at 50 cm. We used the line intercept method to measure vegetation coverage for each plant species. Additionally, in the 1959 category we used metal tags to identify pine trees that will be re-measured to compare pre- and post-fire effects of a scheduled prescribed burn. We will determine species density, richness, diversity and similarity between fire categories. Preliminary analysis suggests that summer wildfires better maintain the natural character of the dwarf pine plains community than winter prescribed burns.

Is the biology of the Mid-Atlantic suburbs sustainable where forest dominant trees fail to reproduce? Chronic irruptions

of midsize predators and midsize herbivores also lead to declines in other vertebrates, and to seven emerging diseases

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Three simultaneous problems have joined to create the deteriorating Mid-Atlantic suburban biology: (1) a half-dozen emerging diseases; (2) the related irruptions of mid-size predators and herbivores; and (3) the consequent failure of forest dominant species to replace themselves.

(1) Six + diseases have emerged in the suburbs: wildlife rabies, Lyme disease, ehrlichiosis, babesiosis, Rocky Mountain spotted fever RMSF, relapsing fever, and raccoon roundworm. Most regional biologists appear unaware of the last five!

(2) Animal populations linked to those diseases have irrupted. Raccoons, foxes, and skunks carry most lab-confirmed rabies. Raccoon density is also key to incidence of RMSF and raccoon roundworm. Three mid-sized herbivores irrupted: deer, rabbits, and woodchucks. Two carry the adult stages of ticks transmitting four diseases. Turtles seem in serious decline while white footed mice and chipmunks, reservoirs of Lyme, flourish.

(3) Hardwood tree species fail to reach competitive heights for regeneration at high deer densities (Tilghman's classic experiments). Wildflowers also decline.

Why now? Six hypotheses: large predators absent, hunting for home consumption reduced, market hunting ended, road effects increased. Added now are: farmers had regulated deer and raccoons, and feral dogs briefly moved into wolf niches and were removed.

The hypotheses of process suggest solutions, with the limitation that road density prevents reintroducing wolves and cougars here. For Lyme, a specific key is that transmission to humans ceases when deer populations are < 8 / square mile (Telford). These plausible actions and limitations can open discussions, including interaction with fragmentation (Ostfield) and invasives. Is there a spectrum of suburban sustainability?

Improving the management of aquatic natural resources through the development, integration, and distribution of spatial datasets

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The Virginia Department of Game and Inland Fisheries (VDGIF) has developed several datasets and an interactive website to assist with natural resource management. In particular, advancements have been made in the tools available to manage aquatic resources. Spatial datasets have been developed that identify threatened or endangered species' waters, anadromous fish usage areas, impediments (Atlantic Slope), and trout streams. Traditionally, Agency datasets have been point locations. In recent years, a shift has been made to depict aquatic natural resources based on the waterbody (stream or lake) in which the species or species group was found. All of these data products are in GIS format. Some of the datasets also have a database component with data entry and functional queries. These data have been distributed to natural resource partners for their general and specific uses. The data are also available through the web-accessible VDGIF Virginia Fish and Wildlife Information Service (VAFWIS). The VAFWIS serves up natural resource data at different access levels and provides several options to search and review the information. A VAFWIS user can search a radius around a point location, perform a custom query of the related databases, or generate a species list by county, watershed, or other existing boundary. The VAFWIS also contains

information on the natural history of Virginia's wildlife including distribution, reproduction, habitat needs, etc. The VAFWIS is used by VDGIF staff, other governmental agencies, NGO's, private consultants, and the general public for a variety of uses including project reviews, natural resource planning, and ecological research.

Sediment nutrient accumulation and nutrient availability in two tidal freshwater marshes along the Mattaponi River, Virginia, USA

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Sediment deposition is the main mechanism of nutrient delivery to tidal freshwater marshes (TFMs). We quantified sediment nutrient accumulation in tidal freshwater marshes upstream and downstream of a proposed water withdrawal project on the Mattaponi River, Virginia. Our goal was to assess nutrient availability by comparing relative rates of carbon (C), nitrogen (N), and phosphorus (P) accumulated in sediments with the C, N, and P stoichiometries of surface soils and aboveground plant tissues. Surface soil nutrient contents (0.60-0.92% N and 0.09-0.13% P) were low but within reported ranges for TFMs in the eastern US.

In both marshes, soil nutrient pools and C, N, and P stoichiometries were closely associated with sedimentation patterns. Differences between marshes were more striking than spatial variations within marshes: both C, N, and P accumulation during summer, and annual P accumulation rates (0.16 and 0.04 g P × m⁻² × yr⁻¹, respectively) in sediments were significantly higher at the downstream than at the upstream marsh. Nitrogen:P ratios < 14 in aboveground biomass, surface soils, and sediments suggest that N limits primary production in these marshes, but experimental additions of N and/or P did not significantly increase aboveground productivity in either marsh. Lower soil N:P ratios are consistent with higher rates of sediment P accumulation at the downstream site, perhaps due to its greater proximity to the estuarine turbidity maximum.

The effects of size variation on ecological interactions in larval *Ambystoma*: Implications for community structure

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Intraguild interactions are common within larval *Ambystoma* that coexist in the temporary ponds of south-central Pennsylvania. Predation and aggressive behavior have previously been examined as factors that play a role in shaping larval salamander community structures; however, factors influencing the prevalence of these behaviors, such as size variation, have not received the same attention. Although many of the origins of size variation within larval salamander communities have been elucidated, the influences of such variation on predation and aggression have not been determined. Using intra- and interspecific pairwise comparisons of larval *Ambystoma* behavior, I quantified the relationship between relative size of larvae and the incidence of predation and aggression. Based on the results of this analysis, several trends are apparent. First,

predation and aggression within larval *Ambystoma* are distinctly partitioned by relative size. Aggressive/submissive behaviors were primarily displayed by individuals that are similar in size, while predation always occurred between larvae exhibiting much greater relative size differences. In addition, distinct interspecific differences in both predation rates and levels of aggression were evident, and these behaviors were determined primarily by the species in question and their relative head widths. These results suggest aggressive behavior functions as competitive interactions between larvae of similar sizes, while predation is a predator-prey interaction between large and small larvae. From these results it appears that it may also be possible to estimate the relative prevalence of predation and aggression within a larval *Ambystoma* community if the degree of size variation within the community is known.

Morphological and behavioral factors influencing mating success and cannibalism risk in the wolf spider *Hogna helluo* (Araneae, Lycosidae).

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In the wolf spider *Hogna helluo*, males exhibit elaborate courtship displays and extended copulation. Males may use courtship to demonstrate body condition or genetic quality, to inhibit female predatory tendencies or to aid in species recognition. Extended copulation may be used to limit the access of other males to the female through the use of copulatory plugs, secretions inhibiting female pheromone production, or through copulatory mate guarding. It could also function as a continuation of courtship. We recorded various male and female behavioral and morphological traits to determine which traits are associated with successful mating and/or cannibalism inhibition. We measured courtship intensity, copulation intensity, male and female body condition, age, and weight. To test for possible non-insemination functions of copulation, the number of insertions by the males was varied. Males were either limited to one insertion or two insertions (one on each side), or were allowed to complete full mating. Preliminary results show males had 55% mating success, suggesting that there is female mate choice during courtship. 10% of males were cannibalized before mating. Females with one insertion were able to produce a full complement of spiderlings, suggesting sperm transfer occurs early and multiple inseminations have functions other than sperm transfer.

Leaf breakdown in urban and forested streams: Effects of leaf type and shredder exclusion

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Leaf breakdown has been studied in a variety of different ecosystems, yet little is known about how it differs between urban and forested streams. Defining that difference is fundamental to a complete understanding of carbon cycling in urban streams. Previous work suggests faster leaf breakdown in southern Piedmont urban streams is due to greater physical fragmentation. We extended that study to the mid-Atlantic Piedmont and compared breakdown of black oak and dogwood leaves in urban and forested streams within the Baltimore Ecosystem Study. We also measured the effect of large macroinvertebrates using large (1 cm) and small mesh (1 mm) leaf packs. Leaf packs were deployed in streams and sampled through time. Packs were dried and weighed to estimate leaf

loss. Invertebrates were sorted, identified to family, and enumerated. Respiration of 20 leaf disks (0.5 cm diameter) was used to estimate microbial activity on leaves. Dogwood decayed faster than black oak, in keeping with previous results. Urban dogwood leaves exhibited faster decay rates than dogwood leaves in forest streams. Leaves of both species decayed more slowly in small mesh than large mesh bags, although the effect was more pronounced in forest streams. The results suggest that decay rates for some species do appear faster in mid-Atlantic urban streams than forested streams. Respiration and invertebrate data suggest that increased rates cannot be attributed to greater microbial or insect activity, but appear more related to hydrology.

Effect of gypsy moth outbreaks on the growth rates of surviving host and non-host trees in a mixed deciduous forest

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The gypsy moth (*Lymantria dispar* L.) is an invasive species in North America that adversely affects the ecology and economic value of forests. Gypsy moths preferentially defoliate some tree species (hosts), causing reduced tree growth rates and mortality. We are quantifying growth losses of host trees and testing the hypothesis that non-host trees will experience growth gains due to reduced competition from host trees. Our study site is a mixed species forest stand in southcentral Pennsylvania that was first invaded by gypsy moths in the 1970s. Subsequent years of gypsy moth outbreaks are known from field surveys of defoliation events. Using tree-ring methods, we are creating species-specific regression models relating tree growth rates and climate prior to gypsy moth invasion. We will apply these models to the period following gypsy moth invasion to determine if tree growth during gypsy moth defoliation events differs from expected growth rates based on climate. Our study trees are at least 30 cm in diameter at breast height and include 26 trees of the host red oak group (*Quercus* L., subgenus *Erythrobalanus*), 31 trees of the host maple group (*Acer rubrum* L., *Acer platanoides* L.), and 55 trees of the non-host yellow-poplar species (*Liriodendron tulipifera* L.).

Coarse woody debris in loblolly pine plantations of the southeastern United States

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Coarse woody debris (CWD) plays an important role in forested ecosystems by adding organic matter to soils, providing wildlife habitat, preventing soil erosion, and being an important part of the nutrient cycle. Much CWD research has been conducted in old-growth forests and unmanaged, second-growth forests. However, less is understood about CWD in intensively managed ecosystems, such as southern pine plantations. The objective of this study was to evaluate the volume and determine the decomposition rate of CWD in loblolly pine plantations in the southeastern United States. Our sites were part of a long-term, loblolly pine thinning study that has been monitored annually by a research cooperative between Virginia Tech, the forest industry, and various other forest landowners. The annual monitoring allowed us to sample logs and snags with a known time since death. We measured volume, decay class, and position of CWD and took disks from dead trees. The volume of the disks were accurately measured, oven dried, and weighed to determine density. The results of this study will enable a better understanding of the part CWD serves in intensively managed

forest ecosystems and allow forest modelers to improve their growth and yield models for loblolly pine plantations. Future work includes sampling the wood disks for carbon content to elucidate how CWD functions as a carbon sink in plantations.

Varying hydrology of agro-ecosystems due to earthworm communities

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Earthworms are probably the most significant soil invertebrates influencing soil characteristics and the other soil biota. The experiment was to see if earthworms contributed to significant differences in infiltration due to varying abundances of earthworms. The study site at the USDA Farming Systems Project has a long term experiment under way to test different crop rotations and management practices. The plots we used were limited to corn on the no-till, organic, and conventional systems. Earthworm activity was calculated by extraction sampling using mustard seed on 50 cm by 50 cm quadrats. Both biomass and density was higher in the no-till plots than in the organic and conventional plots (Biomass- 84/meter² in no till and between 5/meter² and 2/meter² for organic and conventional, Density- 93/meter² in no till and between 5/meter² and 1/meter² for organic and conventional). Infiltration measurements were gathered by using two types of devices. A small diameter double ring ponding infiltrometer was used to collect pair-wise comparisons between areas with burrows and areas with no burrows. The second infiltration device was a Cornell rainfall simulator. This device can be calibrated to replicate different rainfall rates and can provide not only infiltration rates but also sorptivity and hydraulic conductivity values. The ponding infiltrometer clearly demonstrated the differences between areas with burrows and areas without, with the infiltration rates varying by orders of magnitude. The rainfall simulator showed the differences in infiltration due to management practices. The organic and till plots had very high infiltration rates after tilling and as the soil settled, the infiltration rates decreased accordingly.

Integrating science and policy: What we can do

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As a result of the Second World War the physical sciences were the most influential of the sciences in shaping public policy in the United States. Beginning in the 1960's, however, the biological sciences have increasingly gained importance in influencing public policy. Rachel Carson's landmark book *Silent Spring* and mounting public concerns over the quality of the environment have promoted an increasing reliance on the biological and ecological sciences to uncover and solve environmental problems. Indeed, most of these problems were uncovered through the research of biologists and ecologists. Solutions, however, have not been forthcoming, have confused the public, or have for various reasons been ignored in the political process. If the biological and ecological sciences are seen as incapable of solving problems, they will lose public and political support. Moreover, if biologists and ecologists are unable or unwilling to attempt to integrate their science into the political process, non-scientific criteria will inevitably prevail in the making of

environmental policy. If the biological and ecological sciences are to continue enjoying the support of the public and politicians alike, biologists and ecologists must attempt to understand the difficulties inherent in integrating science with public policy making. My goal in this presentation is to identify and discuss the most challenging barriers separating science and environmental policy. I will discuss the difficulties of integration and conclude by proposing actions that ecologists can undertake to effectively integrate science with public policy. I developed these views based on experiences gained from working as a Legislative Assistant with Senators Daniel Patrick Moynihan and Dianne Feinstein (D-CA).

Establishment of tree seedlings in degraded lands in Southwest Iceland by lupine facilitation

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Vegetation and soils in the Sudurnes region of Southwest Iceland have been highly degraded since settlement 1100 years ago, mostly due to removal of native birch cover and overgrazing by sheep. Efforts to establish trees have proven difficult in this area of high winds, oceanic salt spray, and nitrogen-poor soils. A successful vegetation restoration program initiated in 1998 on the Keflavik NATO Base has resulted in the establishment of large areas of *Lupinus nootkatensis* and grass cover. I hypothesized that lupine will facilitate colonization by Sitka spruce (*Picea sitchensis*), willow (*Salix* sp.), and native birch (*Betula pubescens*) in the Sudurnes region by ameliorating microsite conditions. Afforestation experiments were started in five locations on the base during June 2002. After one year's growth in June 2003, spruce and willow seedlings were significantly taller in lupine than in adjacent control plots, and birch seedlings were taller if one anomalous plot is excluded. Survival of seedlings was higher in lupine plots (> 92% for all species), though not significantly. Transplantation of seedlings into excavated depressions (~50 cm wide and ~20 cm deep) within lupine patches resulted in an additional increase in seedling height for all species. Results after one year indicated that lupine facilitates tree seedling establishment in degraded areas of Southwest Iceland, and planting seedlings into excavated depressions within the lupine stands improves early growth. Future monitoring of the experiments will test the ability of lupine cover to promote afforestation in Southwest Iceland.

Marine animals that secrete high-Mg calcite in modern seas produce low-Mg calcite in seawater of Mid-Cretaceous composition

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The Mg/Ca ratio of seawater has changed significantly over the Phanerozoic, primarily as a function of the rate of seafloor spreading (Hardie, 1996). While laboratory experiments have shown that such chemical variations in the oceans would have influenced the Mg content of abiotic calcite precipitates (Füchtbauer, H. & Hardie, 1976), its affect on biotic calcite has been relatively unexplored. Here I show that the Mg content in the skeletons of 4 different animals (echinoids, crabs, shrimps and calcareous serpulid worms), which produce high-Mg calcite (> 4 mol % MgCO₃) in modern seas, varies proportionally with the Mg/Ca ratio of the artificial seawater in which they are grown. Specimens grown in artificial seawater with the lowest Mg/Ca (~ 1) actually changed their mineralogy to low-Mg calcite (< 4 mol % MgCO₃). These experiments suggest that the skeletal

chemistry of modern high-Mg calcareous organisms has varied significantly over the Phanerozoic as a function of the Mg/Ca of seawater. During the Mid-Cretaceous, when oceanic Mg/Ca was lowest (~ 1), it is likely such organisms changed mineralogy to low-Mg calcite. Furthermore, the Mg content of unaltered fossils of such organisms may be a record of oceanic Mg/Ca throughout the Phanerozoic.

Phenotypic plasticity in outbred and selfed *Mimulus ringens* under soil moisture stress

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Plants exhibit phenotypic plasticity as a coping mechanism for environmental heterogeneity. These plastic changes in morphology and physiology are not heritable, although the ability to be plastic can be inherited. The mating system (outbred or inbred) a plant utilizes could influence the degree of plasticity inherited by the progeny. The most extreme case of inbreeding, selfing, results in offspring with 50% less heterozygosity than the parent plant. This reduction in heterozygosity could lead to decreased heterosis and/or an inability to mask deleterious alleles. If an inbred plant has a lower ability to be plastic, its survival and reproduction may be threatened under certain environmental stress. Species found in ephemeral wetlands would seemingly benefit from maintaining high levels of plasticity to cope with frequent changes in soil moisture.

This study examines the effects of inbreeding on phenotypic plasticity in *Mimulus ringens* under soil moisture stress. Field experiments were conducted to test for phenotypic responses to stress for 16 genotypes. Characters measured include both fitness and morphological traits. This paper presents results for field data on total aboveground biomass, seed biomass, plant height, corolla width and height, herkogamy and first flowering date for both inbred and outbred individuals. The results suggest that for some characteristics outbred and inbred plants both exhibit phenotypic plasticity between treatments while plasticity is exhibited for one or neither breeding strategies for some characteristics. The amount of phenotypic plasticity is not consistent between characteristics.

Increasing temperate forest vulnerability to weak storms: Hurricane Isabel and the implications for changes in Piedmont forest composition

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A 1 ha permanent forest plot in the Piedmont of Maryland suffered heavy damage – 21 to 28%, by various measures – from Hurricane Isabel on 18-19 September 2003. This level of damage occurred despite the storm's low intensity and considerable distance from the study plot, and the forest's lack of characteristics known to increase vulnerability to wind. Comparisons to a nearby plot and to other forests in the region suggest that the heavy damage was due to the trees in this maturing secondary forest having reached large heights and basal areas. This is likely to become increasingly frequent in mid-Atlantic inland forests in the next few decades, suggesting a changing disturbance regime. Data from pre-hurricane surveys include detailed information on the size, species and damage category of all trees > 10 cm DBH. We are currently collecting

data to predict potential changes in forest composition based on damaged tree mortality and regeneration.

Rodents under cover: Apparent competition between hay-scented fern and tree seedlings mediated by small mammal predation

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An extension of the classic apparent competition model posits that, by providing a favorable microhabitat for herbivores, one plant species can indirectly reduce densities of a second species by facilitating increased predation. In forest understories dominated by a dense herbaceous layer, this pathway provides a compelling alternative to competition in explaining understory layer interference on tree seedling recruitment. We tested this model in forest understories of the Allegheny National Forest (PA) dominated by hay-scented fern (*Dennstaedtia punctilobula*) and predicted that the presence of a fern canopy elevates rodent activity thereby decreasing seedling establishment. We predicted that seedling establishment would be lowest in areas subject to both fern and rodents and highest in areas without rodents and fern cover. To determine the impact of both fern and rodents we used a factorial field manipulation of mammalian activity using exclosures and fern cover presence/absence at three sites. Trapping and seed removal data confirmed the fences effectively removed small mammals and documented elevated mammalian activity beneath fern cover. Seed removal trials revealed strong seed preferences by rodents, but only in the absence of fern cover. Finally, as predicted, seedling densities were greatest in exclosures without a fern canopy and lowest in unfenced, fern-covered plots. This is one of a few examples documenting apparent competition in plant communities and our short-term results demonstrate that microhabitat influenced predation strongly limits seedling establishment. Therefore, discerning the role of small mammals is critical as it could force us to reevaluate our understanding of the factors structuring forest communities.

Morpho-species richness and abundance of ground-dwelling arachnids in northern California

grasslands: the role of plants, soil, and dominant species

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We examined the role of 3 dominant ant species (*Messor andrei*, *Pheidole californica*, and *Solenopsis xyloni*), plants and soil attributes on morpho-species richness and abundance of ground arachnids in a northern California serpentine grassland. Pitfall traps were used to collect spiders, scorpions, and mites at 160 sites over a 2-week period in May 2003. From the traps, all arachnids were counted and sorted to morpho-species for a total of 1154 spiders, 11 scorpions, and 84 mites. Spiders formed positive relationships with plant characteristics and both positive and negative associations with the 3 dominant ant species at this locale. There was not a strong relationship between soil attributes and any of the arachnid groups.

Field evidence of an airborne enemy-avoidance kairomone in wolf spiders

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Hogna helluo, *Pardosa milvina*, and *Trochosa ruricola* are three syntopic species of wolf spider common to agricultural fields in the Eastern United States. The larger species, *Hogna helluo*, is a common predator of the two smaller species. *Hogna* is

nocturnally active but frequently resides within soil fissures during the day and may attack *Pardosa* (diurnal) or *Trochosa* (nocturnal) that enter or walk near these fissures. The ability to detect airborne chemical cues associated with these predators (enemy-avoidance kairomones) may allow *Trochosa* and *Pardosa* to avoid *Hogna*-containing fissures from some distance. We tested for the presence of an enemy-avoidance kairomone on avoidance behavior among *Pardosa* and *Trochosa* under field conditions. To simulate soil fissures and control for visual and vibratory means of predator detection, we baited funneled pitfall traps with one of the following (N = 20 traps/treatment): 1) adult male *Hogna*, 2) adult female *Hogna*, 3) a house cricket (*Acheta domestica*), or 4) an empty trap. *Pardosa milvina* showed a significant avoidance of pitfall traps baited with *Hogna* of either sex while *Trochosa* showed no significant avoidance of *Hogna* baited traps. To our knowledge, this study demonstrates the first evidence of an airborne enemy-avoidance kairomone mediating spider behavior.

Community composition of soilborne pathogens in an old field: Implications for *Prunus serotina* seedling survival and succession

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The Janzen-Connell Hypothesis suggests that host-specific predators help maintain tree species diversity by creating an area near the tree where tree's own seedlings are at a disadvantage relative to seedlings of other tree species. Soilborne plant pathogens may serve the same function as host-specific predators, depressing seedling survival near conspecific trees. In this study we examined the composition of the pathogen community in the *Prunus serotina*-*Pythium* model system. Previous studies have indicated that *Prunus* seedling mortality decreases with increasing distance from the parental tree and that at least one *Pythium* species plays a direct role in reducing seedling survival close to the parent tree. We used reverse-dot-blot hybridization (RDBH) techniques with *Pythium*-specific primers to compare *Pythium* community composition near a hedge row populated with *Prunus* trees to *Pythium* composition 75 meters from the hedge row in a recently abandoned agricultural field. Extracted soil DNA from these intervals allowed identification of all *Pythium* species present. Differences between *Pythium* community composition at the hedge row and in the old field provide insight to which *Pythium* species are most pivotal to *Prunus* seedling succession following release from land use, as well as the spatial patterns of *Prunus* colonization during succession.

Cache pilferage in free ranging Gray Squirrels

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Although it is well known that squirrels store food for future use, little is known about how they manage these caches. This study sought to quantify patterns of cache recovery and pilferage of conspecific competitors. In order to do this we presented PIT tagged acorns to uniquely marked eastern gray squirrels (*Sciurus carolinensis*) in an urban park (Kirby Park, Wilkes-Barre, PA). The caches were mapped and monitored in order to determine how long acorns remained in the ground, and whether or not they were recovered by the hoarder, or pilfered by another squirrel. In addition to these data, we present data from a previous study, which monitored the removal rates of caches that were experimentally placed by a human observer. During both

summer and fall periods, squirrel cached acorns ($n = 175$) remained in the cache for less than six days. Of the 32 caches in which retrieval was observed, 24 were pilfered by a naïve conspecific, while 8 were recovered by the original hoarder. The majority of acorns (83%) were then eaten rather than re-cached. This indicates a high degree of cache pilfering in natural populations and suggests tree squirrels might need to regularly monitor caches in order to evaluate and respond to cache losses.

Mechanisms of UV radiation tolerance displayed by benthic macroinvertebrates

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Little or no information is available on the mechanisms of UV tolerance exhibited by stream macroinvertebrates. This study used a standard UV exposure apparatus (UV phototron) to examine the UV tolerance of several species of mayfly nymphs. The UV phototron separates UV tolerance into two component mechanisms of defense: photoenzymatic repair (PER) and dark repair and photoprotection (DRPP). Nymphs of the dominant mayfly species were collected from seven study streams with varying UV transparencies from the Lehigh River watershed. Organisms were exposed to multiple levels of UV in the phototron in the presence and absence of photorepair radiation (PRR). UV tolerance in all mayfly species was substantially greater than the tolerance of zooplankton collected from lakes in the same geographic region. Tolerance was not, however, related to the UV transparency of the stream. Of the four species for which the mechanisms of UV tolerance were examined, two depended heavily on PER while the other two depended almost exclusively on DRPP. This is the first study to document PER in benthic macroinvertebrates in streams. Even with the substantial levels of DRPP and PER used by some benthic macroinvertebrates, mayflies are likely to incur UV damage in the absence of behavioral avoidance of full solar UV in the benthos of streams.

Land use effects on amphibian use of retention ponds and larval metal concentrations

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Stormwater retention ponds may provide amphibian habitat, especially given marked global wetland loss. However, because retention ponds sequester a variety of pollutants and are located in human-dominated areas, scientists have expressed concern over wildlife use of these ponds. Using twenty retention ponds in the Baltimore-Washington metropolitan area, I investigated effects of adjacent land use on amphibian species richness and metal (Al, Cr, Ni, Cu, Zn, As, Cd and Pb) concentrations in anuran larvae (bodies and guts separated) and sediments. Ponds were categorized based on surrounding land use (residential, commercial, highway and industrial). Mean species richness was lowest at highway ponds (3.2 ± 1.9 ; ± 1 SD), and greatest at open space ponds (9.3 ± 1.5 ; ± 1 SD). Residential and commercial ponds showed intermediate levels of species richness. Green frog (*Rana clamitans*) larvae from commercial ponds had the highest mean concentrations of Cr, Ni, As, Cd, and Pb in both body and gut samples, while lowest mean body concentrations of Cr, Ni, As, Cd, Pb and Zn, and lowest mean gut concentrations for Cr, As and Cd occurred in open space ponds. These results indicate

that consideration of retention pond placement in the landscape may enhance wetland function.

Effect of pollination distance on viable seed production of *Gentianopsis crinita* (Frole.) Ma. (fringed gentian).

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Populations of Maryland state-threatened *Gentianopsis crinita* vary in number and proximity at Soldiers Delight Natural Environment Area, a serpentine outcrop. Small populations were observed to produce seeds with low viability as measured by germination success. Large populations, conversely, exhibited higher rates of germination. We hypothesized that compatibility factors contributes to low germination in populations with limited potential pollen donors. To test this hypothesis, individuals from large and small populations were hand pollinated from close (< 5 m) and distant (> 50 m) sources, and then seed germination rates were compared with individuals that were enclosed prior to floral opening and to naturally pollinated flowers. We found that these gentians only produce viable seeds with external pollination, and that hand pollination was as effective as open pollination. Finally, there were no consistent differences in seed viability based upon the distance of the pollen donor.

Invasive plant response to natural disturbance in a Piedmont forest in Maryland

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A one-hectare permanent forest plot in the Piedmont region of Maryland was damaged by Hurricane Isabel in September 2003. We subdivided the plot into 400 5X5 meter quadrats, along with an adjacent, 4-hectare, less damaged control plot. We surveyed both plots for the presence and percent cover of 12 exotic invasive plants, all present in or within 100 m of the study area. We have made predictions of: 1). the response of the 12 exotic invasives to the creation of light gaps and the disturbance of soil by uprooting. 2). the patterns of invasion into the study area. 3). the relative success of the invaders based on species characteristics.

4). the impacts of the invasion on native flora in response to natural disturbance.

This work provides an opportunity, using a natural disturbance, to test whether chance, dispersal and history, or adaptation and competition for resources, are more important in determining response to disturbances.

Chemical gradients within acorns suggest evolutionary responses to enhance dispersal

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Oak-small mammal interactions create a complex selective environment for acorns given the dual role of small mammals as seed dispersers and predators. We present evidence that oaks have adapted to this environment by producing seeds whose apical and basal portions differ significantly: with basal sections providing a dispersal reward for small mammals and the apical portion providing embryo protection. Chemical analyses of acorns across three species of oaks (*Quercus rubra*, *Q. palustris*, *Q. alba*, $n = 16 - 22$ trees each) reveal higher lipid levels in the basal portion of the acorn and higher tannin levels in the apical portion. Sodium levels were also found to be higher in the basal half of *Q. rubra* acorns. Discriminant functions for all three species definitively classify apical versus basal sections of acorns using a variety of chemical attributes (jackknifed classification rates ranging from 79 to 91%). In addition, outdoor plot experiments demonstrate a low but consistent frequency of seedling establishment of partially eaten acorns (establishment ca. 10% for $n = 1000$ acorns per species). These results, coupled with the fact that five species of seed predators are known to selectively consume the basal portion of red oak acorns while leaving the apical end intact, suggest acorn structure is more intricately adapted for dispersal than previously thought.

Tests of diversity cascades and resource concentration models in *Piper cenocladum* and associated arthropods

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Some of the most interesting challenges faced by terrestrial ecologists today include understanding and describing the interactions occurring within small-scale tropical food webs. Several conclusions have been presented that attempt to explain these interactions and the effects of disturbances cascading through the trophic levels of the webs. Additionally, controversy exists regarding the ability of tropical systems to recover from these disturbances. In this study I looked at the effects of a top-down disturbance on distant trophic levels and the possibility that terrestrial systems have the inherent diversity to recover from these disturbances. Additionally, I looked at the concentration of an abiotic resource affecting trophic levels from the bottom-up by determining the dispersion pattern of *Piper cenocladum* and testing the resource-concentration hypothesis. In this study, I observed a recovery in the terrestrial plant community after a tri-trophic level disturbance. I also concluded that *P. cenocladum* has a clumped dispersion pattern, and clumped planting sites had a higher insect species richness, supporting the resource-concentration hypothesis. These results support the idea that the diversity of tropical terrestrial systems may allow them to recover from small-scale disturbances felt through trophic levels and that the dispersion patterns of some plants may be responsible for the high insect species richness associated with them.

Vegetative herbivory affects the mating system of *Impatiens capensis*.

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Vegetative herbivory can affect plant mating system directly, by lowering plant resources or indirectly, by influencing pollinator

visitation to damaged plants. In natural populations, we manipulated herbivory levels to investigate the mechanisms by which herbivory affects the mating system of *Impatiens capensis*, a species with mixed-mating system (producing both cleistogamous, obligately selfing flowers, and chasmogamous, facultatively outcrossing flowers). We found that herbivory affected the mating system directly by increasing the proportion of flowers and seeds that were cleistogamous. In addition, herbivory affected characteristics associated with the mating system including chasmogamous floral display size and floral attraction traits, resulting in a decrease in pollinator visitation to damaged plants. Further, the composition of the pollinator fauna differed between high and low herbivory environments. The significant decreases in chasmogamous flower number, flower size, and pollinator visitation as well as changes in the pollinator fauna composition may lead to changes in the outcrossing rate of chasmogamous flowers. Our findings are among the first to demonstrate that herbivory has direct consequences on plant mating system and should be considered a factor shaping mating system evolution.

Correlation of spatially-variable fish species diversity with groundwater inflows in an urbanized stream system

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Valley Creek watershed is a small stream system that is tributary to the Schuylkill River near Philadelphia, Pennsylvania. The watershed is highly urbanized, including over 17% impervious surface cover (ISC) by area. Imperviousness in a watershed has been linked to fish community structure and integrity. Generally, above 10-12 % ISC there is marked decline in fish assemblages with fish being absent above 25 % ISC. Very different patterns of fish assemblages emerged in Valley Creek watershed at stations where the groundwater contributed significantly to the stream flow. This study quantifies the importance of groundwater in maintaining fish species diversity even in sub-basins with over 30 % ISC. Fish communities were quantified at thirteen stations throughout the watershed and Simpson's species diversity index was calculated. One hundred and nine springs were also located and their flow rates measured. A cross-covariance analysis between Simpson species diversity index and spring flow rates upstream of fish stations was performed to quantify the spatial correlation between these two variables. The correlation was found to be highest at lag distances up to about 400 m and drop off significantly beyond lag distances of about 800 m. Groundwater improved the stream habitat with its average temperature of 10.4 °C, allowing for better fish assemblages despite over 30 % ISC.

The effects of lawn care on arthropod diversity

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Many soil arthropods are important decomposers, specifically they are responsible for physically mixing organic matter and adjusting the soil physical properties to levels more conducive for organic matter decomposition. Though the majority of the United States population resides in urban and suburban areas, it is poorly understood how cities function as ecological systems. The Baltimore Ecosystems Study (BES) is a Long Term Ecological Research project that explores metropolitan Baltimore as an ecosystem. My objective was to relate lawn care maintenance to arthropod diversity and species richness. I collected samples using pitfall traps and mesofauna extraction. Sampling was conducted in a neighborhood in Carney, MD in the spring and summer of 2003. Twelve lawns were selected and separated into 3 maintenance categories (high, medium and low) based on the number of fertilizer applications per year. A nearby forest was used as a reference site. I found that mites were more abundant in high maintenance lawns. Collembolla were more abundant in low maintenance lawns. Mites and Collembolla abundance in lawns increased as organic matter increased.

The role of environmental factors in the germination of *Campanula americana*

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Seeds of *Campanula americana*, an herb native to eastern North America, germinate in sloped woodlands in April and October. To explain this pattern, we examined how factors including photoperiod, soil, burial depth, leaf-litter cover, and wet-dry cycles influenced *C. americana* germination. Photoperiod did not affect germination percentage, except that few seeds germinated in continuous darkness, but it did affect the timing of germination: seeds germinated earliest in a 12:12 L:D photoperiod and later in 10:14 L:D. Thus, photoperiod probably does not force germination into April and October. Seeds did germinate in soil collected from locations in which *C. americana* is known to grow, but the results for soil from the sites where it does not occur were mixed: soil from one such site promoted germination but soil from another site inhibited it. Thus, soil type may affect germination in the wild. Exposure to wet-dry cycles reduced both the percentage and speed of germination. Germination percentage and speed generally decreased as depth of burial in soil increased, except that poor germination occurred with seeds not buried at all. Leaf-litter cover also reduced germination percentage as its depth increased, but did not affect speed. This may partially explain why the species grows on slopes, where litter does not accumulate deeply. Since no single factor accounts for when and where this species germinates in the wild, the process is probably controlled by a complex interaction of several factors.

***Narceus annularis*: Native millipede of the Mohonk Preserve**

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Millipedes are an important component of the decomposer food web, consuming fallen leaf litter and aiding in its conversion to soil matter. In spite of their abundance in many areas, very little is known about most species. I conducted experiments with the native *Narceus annularis*. This species is rather large, growing up to about 80 mm in length and weighing up to over 3 grams. *Narceus annularis* seasonally migrate to lower elevations during

August and September, eliminating much of the leaf litter in their path. 50 individuals were collected for a colony from the Mohonk Preserve in New York State during this migratory time in 2003. I have conducted feeding experiments using red oak, chestnut oak, cherry birch, and white pine, the most abundant trees in their habitat. By weighing the animals, leaves, and fecal matter before and after the experiment, I calculated the assimilation rates for each leaf type. Feeding rates ranged from about .01 gram consumed per gram animal per day for the oaks to about .06 g.consumed/g.animal/day for the cherry birch. Although the millipedes consumed more cherry birch, the assimilation rate is about half of that of that of the oak leaves. By using time-lapse photography, I have conducted food preference experiments with natural (leaves from habitat) and artificial (lettuce, carrots, apples) foods. The natural food was preferred over the artificial, with all leaf types being consumed but only the apples being consumed of the artificial. The camera we set up enables us to display experiments online.

**A field test of the Reproductive Assurance Hypothesis:
Pollinator failure in populations of *Collinsia verna*
(Scrophulariaceae) results in adaptive mixed mating**
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The evolution of self-fertilization in hermaphroditic animals and plants is opposed by genetic costs that discount selfed progeny's value relative to outcrossed progeny. However in plant populations, self-fertilization is common and up to a third of the species tested have outcrossing rates intermediate between pure selfing and pure outcrossing. Darwin first hypothesized an adaptive benefit of self-pollination in assuring reproduction when outcrossing is impossible, but positive empirical support for the RA hypothesis under lesser degrees of pollinator failure has been lacking. We suggest that to demonstrate adaptive reproductive assurance, three conditions must be operating: 1) scarce pollinators or mates limit seed set, 2) autonomous selfing boosts seed set and, 3) low genetic costs of selfing. Here we present field data and marker-based estimates of selfing rate and show that these conditions exist in three natural populations of *Collinsia verna*. Moreover, we show that population estimates of selfing rates increase proportionally with the level of pollinator failure ($R^2 = .62$, $p < .05$). Our results provide the first complete empirical support of the RA hypothesis and the first mechanistic link between reproductive assurance selfing and adaptive mixed mating.

Turtles versus Ducks: Effects of a wetlands drawdown on aquatic turtles

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Manipulations of water levels in wetlands are commonly practiced by land managers, but their effects on reptiles and amphibians are studied only rarely. Starting in 2003, we examined the effects of such a drawdown (the draining of an impoundment), on the painted turtle, *Chrysemys picta*, at the Patuxent National Wildlife Refuge in Laurel, Maryland. Thirty one adult female painted turtles from the drawdown site and a control site were radio-tracked before, during, and after the drawdown event occurred in July 2003. We also used hoop traps, a drift fence, and hand captures to monitor movements of turtles

among impoundments. Of the 16 turtles from the drawdown site, 12 left the impoundment after the pond levels began to drop and only 4 remained in the impoundment by the end of activity in November. By contrast, 10 of the 15 turtles from the control site remained in the pond by November. Mortality of radio-tagged turtles from both sites was low, 12% from the drawdown site and 0% from the control site. Data on overwinter survival are currently being collected. Our results suggest that water level manipulations can have major implications on the population structure of painted turtles.

Organic carbon loss from various soil types due to biomass burning

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Recent research has highlighted the global significance of carbon release from soil during anthropogenic and natural fires (Page et al, 2002; Schuur et al, 2002). The goal of this study is to document changes in the percent organic carbon and $\delta^{13}C$ values caused by exposure to temperatures seen in low- (200-300°C) to high-intensity (>500°C) fires. Soils were collected from sites in Delaware and Maryland, oven dried and exposed to elevated temperatures in a muffle furnace. Soils and soil horizons sampled spanned a range of soil type (Mollisol, Inceptisol and Ultisol); of percent organic carbon (0.11-26.6 %C); of % clay (0-22% clay); and were associated with widely different vegetation (hardwood forest to pine forest to salt marsh grass). The results from this study establish % C and $\delta^{13}C$ changes corresponding to 6 hour periods of heating of the soil, which corresponds to the likely maximum changes in % C and $\delta^{13}C$ for the different horizons. For % C, 60 to 94% of the carbon loss occurred between 200 and 350°C. An increasing trend of $\delta^{13}C$ values between 200 and 400°C for organic horizons dominated by woody plant inputs is attributed to individual components in the organic matter, which are combusted at particular temperatures with compounds containing heavier carbon being left behind as temperature increases.

Prevalence of raccoon roundworm (*Baylisascaris procyonis*) as a factor in the disappearance of the Allegheny woodrat (*Neotoma magister*) in Ohio

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The Allegheny woodrat (*Neotoma magister*) is listed as threatened, endangered or extirpated in eight states of the northern portion of its historic range. One suggested cause for the species' disappearance is fatal infection by the raccoon roundworm *Baylisascaris procyonis*, to which the woodrat's habits may make it particularly vulnerable, with infection occurring when foraging woodrats collect raccoon feces containing embryonated roundworm eggs. In Ohio, where woodrats were formerly widespread, recent surveys of appropriate habitat indicate that active Allegheny woodrat populations remain only in Adams County. We collected 90 raccoon scats at the Adams County sites and in formerly occupied woodrat habitat in Hocking County and used centrifugal flotation and microscopic examination to assay the scats for presence of *Baylisascaris* eggs. We report frequencies of infected scats at sites in both counties in relation to the

hypothesis that exposure to *Baylisascaris* has played a major role in extirpation of the woodrat in Ohio.

Natural fluctuations in amphibian population size

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Amphibian decline is well documented and there has been progress towards understanding the underlying causes for many species. Surprisingly, natural levels of population fluctuation in amphibians and their causes are poorly documented compared to many other taxa (small mammals, forest insects, herbaceous plants). Here we report on 15 yrs of census data on two salamander populations. In high-alpine wetlands near the Rocky Mountain Biological Laboratory in central Colorado, we have observed dramatic, cyclic changes in the population size of tiger salamanders (*Ambystoma tigrinum nebulosum*). A combination of long-term demographic data and short-term experiments suggest that these cycles are intrinsic and probably driven in part by inter-cohort cannibalism. That one of the decline phases in this population was attributed to acid rain emphasizes the importance of distinguishing the effects of human impacts from natural fluctuations. In contrast, population monitoring of a spotted salamander (*Ambystoma maculatum*) population near Allegheny College in western Pennsylvania reveals less evidence for cyclic fluctuations, although the population size has steadily increased over the past 10 years. Our inability to make strong inferences about the underlying cause(s) of this increase compared to the cycles in Colorado emphasizes the complementary roles of long-term natural history and demographic information, community data (food resources, competitors, predators), and short term experiments for testing alternative hypotheses about the causes of long-term changes in the size of amphibian populations.

The heterogeneity of soil characteristics in a residential neighborhood: Cub Hill a case study

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We have been investigating the spatial pattern of soil characteristics and invertebrate populations in a residential area near the flux tower at Cub Hill, Baltimore County. One objective of this study was to determine if residential lawns, planting beds, and forest cover types differed in their soil characteristics given that the soil developed from the same parent material. Composite soil samples to a depth of 5 cm were taken from planting beds and lawns from 50 residences within a 300 m diameter area around the flux tower. An adjacent forest patch was also sampled. Characteristics such as slope, percent impervious, and aspect were completed for every delineated polygon. Soil test results included the following parameters: P, K, Mg, Ca, pH, and organic matter. Results showed that forest, bed, and lawn (n=595) areas contained significantly different concentrations of Mg, P, K, Ca, and organic matter; and had a significantly different pH (p<0.05) even though the parent material of the native soils were the same. However, there was no significant difference for pH between forest and bed areas and between bed and lawn areas.

Within the dataset, Ca and pH are the most highly correlated variables (r=0.798) followed by Mg and pH (r=0.500) and Mg and Ca (r=0.533). A principal component analysis reveals that pH, Mg, and Ca explain 42.6% of the variability of the dataset and organic matter explains 18.5%. In the future, soil characteristics will be related to soil invertebrate data, age of housing development, and individual residence's maintenance practices.

A behavioral analysis of *Tursiops truncatus* in the Assateague Island region.

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The Atlantic coastal bottlenose dolphins (*Tursiops truncatus*) were listed as depleted under the Marine Mammal Protection Act of 1972 due to a mass stranding in 1987-88 that killed 53% of the population (750 animals). Following this event a number of studies were set up along the U.S. Atlantic coast to both determine more exact population numbers and to better understand the behavioral ecology of this rare species.

We performed dawn to dusk observations of *T. truncatus* behavior from May to October 2003 combining both land-based and at sea observations. Fluke slapping was by far the most prominent behavior. June and August had the most observed behaviors of the months studied. Traveling behavior decreased in 26°C water and dolphins devoted more time to recreational behaviors. Overall, dolphins become more active in warmer waters. Approximately 29 through 31%, appeared to be an optimal salinity for dolphins, possibly due to osmotic balance and regulation. Frequency of the fluke slap doubled during incoming and high tides. Due to its warning nature, this may be a signal between dolphins of tide states. There was a strong negative correlation between any behavior and calm seas. Ongoing behavioral work is assessing whether dolphin group size correlates with sexual activity, and whether more sexual activity occurs when groups mesh to form larger groups.

Relationships between an invasive plant species, Japanese knotweed (*Polygonum cuspidatum*), and understory vegetation in riparian zones in southwestern Pennsylvania

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Japanese knotweed (*Polygonum cuspidatum*) is an invasive, exotic species that has caused extensive damage in Europe and parts of North America. Although this noxious weed is widespread throughout Pennsylvania, little research has been conducted to quantify the effects of its encroachment on surrounding plant life. We are studying plant communities within Southwestern Pennsylvania riparian zones to measure the effects of knotweed proliferation on understory vegetation. We will also be sampling the aboveground and belowground biomass of knotweed to understand the structure of the species. From initial field investigations, we were able to infer that the incursion of knotweed on plant communities drives species richness down by using resources (e.g., light, water, nutrients). By examining biomass, we determined that knotweed, despite high production of seeds, reproduces mostly by vegetative means. Knotweed constitutes an imminent threat to plant and animal communities. This continuing research illustrates the need for a comprehensive management plan to control knotweed.

A model for reclaiming severely disturbed upland areas in the New Jersey Pinelands

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The New Jersey Pinelands contain some of the largest semi-wilderness areas along the mid-Atlantic coast. The region supports large tracts of a globally rare dwarf pine plains community. This fire-dependent community is characterized by a diminutive, closed-cone variety of pitch pine (*Pinus rigida*) and shrub oaks. Gravel extraction practices in the pine plains and other pine-oak upland communities have resulted in highly disturbed landscapes that typically remain devoid of native vegetation for years following the cessation of mining operations. Consequently, these fragmented landscapes are severely eroded and serve as unnatural firebreaks that may encourage undesirable

recreational vehicle use. Developing successful revegetation strategies for areas such as these is beneficial and ecologically important. We present here the results of a reclamation project initiated in the spring of 2001 on a severely degraded 25-year-old abandoned gravel pit (0.81 hectare). Previous attempts to restore the site with pitch pine saplings proved unsuccessful. We developed a revegetation model using soil amendments and native warm season grasses that demonstrated an increase in vegetation density, cover, and diversity after three growing seasons. Density of little bluestem (*Schizachyrium scoparium*) varied with mulch application and was greatest in areas with intermediate mulch thicknesses. Areas of maximum density in the study site (32.0 indiv/m²) exceeded the mean density measured in a reference site (23.2 indiv/m²) undergoing natural succession. By developing a successful revegetation strategy, we can apply this model to restore similarly disturbed sites in upland Pinelands habitats.