

**POSTER ABSTRACTS  
ESA MID-ATLANTIC CHAPTER  
ECOLOGY CONFERENCE 2005**

**A. Plant Physiology/Ecology**

**1. Comparative study of fruit predation and clonal incidence between an invasive and native *Rubus***

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Invasive species can out compete existing native vegetation and strongly impact the economy, environment, and human health. Comparative studies of invasive and native species are necessary in order to determine why the invasives flourish in a habitat. The sexual reproduction, through fruit predation, and asexual reproduction, through clonal growth, of two *Rubus* species, *Rubus phoenicolasius* M. (invasive wineberry) and *Rubus argutus* L. (native blackberry) were studied at the Smithsonian Environmental Research Center (SERC), Maryland, in 2004. Greater fruit predation may lead to greater dispersal throughout an area and is beneficial because seeds that pass through the gut may have increased germination. To compare rates of fruit removal by fruit predators between invasive and native *Rubus*, the development of fruit on plants was monitored. *R. phoenicolasius* had a significantly higher rate of fruit predation ( $t_{1,204}=3.58$   $P<0.001$ ), whereas *R. argutus* had a higher rate of fruit abortion and desiccation ( $t_{1,204}=26.37$   $P<0.001$ ). These data suggest increased seed dispersal for *R. phoenicolasius*, which may lead to increased fitness. In addition, increased frequency of clonal reproduction for *R. phoenicolasius* would allow it to succeed locally. To compare frequency of clonal reproduction between invasive and native *Rubus*, individuals were sampled along belt transects. Although clonality does exist in both species, low incidence of clonal propagation was observed (clonal individuals observed: native= 2/86; invasive=0/91). Even though the invasive and native *Rubus* have similar life histories, the success of the invasive may be because of its increased ability to propagate new individuals throughout a habitat.

**2. The phenotypic plasticity of fluctuating asymmetry in two plant species, *Lythrum salicaria* and *Penthorum sedoides***

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The phenotype of an organism is influenced by both genes and its environment, and therefore, a single genotype can produce different phenotypes in response to different environmental conditions. Often environmental stress can disturb developmental processes disrupting cell growth, enzymatic, or physiological processes and can affect symmetry of a trait. Fluctuating asymmetry (FA) is a measure of such developmental noise and can be assessed by quantifying the deviation from the perfect symmetry of a bilaterally symmetrical trait. We intend to investigate phenotypic plasticity of FA and

compare between an invasive and exotic *Lythrum salicaria* and a native species *Penthorum sedoides*. Thirty genotypes of both species were cloned to produce six genetically identical plants of each genotype and were subjected to two nutrient treatments. The largest and healthiest leaf of each plant was sampled before and after treatments were applied and plant height was recorded. The length, total width, and width of left and right sides (from central vein) were measured using digital calipers. We expect that leaf FA will vary among genotypes of both species and will also be affected by the available nutrient content of soil.

## **B. Physiology/Ecology**

### **3. Effect of fish predation on ontogenetic metabolic scaling in the freshwater amphipod *Gammarus minus*.**

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A fundamental generalization in biology is that respiration (metabolic) rate ( $R$ ) of an organism scales to body mass ( $M$ ) according to the power function,  $R = aM^b$ . It has been widely accepted that the scaling exponent  $b$  is  $3/4$  (0.75), the so-called “ $3/4$ -power law”. Typically, this law has been explained in terms of internal (physical) constraints associated with body design. However, the effects of external (environmental) factors on metabolic scaling have been under appreciated, despite that fact that several studies have shown that  $b$  can be environmentally sensitive. The purpose of this research is to determine whether fish predators affect the metabolic scaling of the freshwater amphipod *Gammarus minus*. Scaling exponents of log oxygen consumption rate in relation to log body mass were compared among amphipod populations in two springs with fish (*Cottus cognatus*) predators and two without. Although ANCOVA revealed only marginally significant differences in  $b$  among the four populations ( $F_{3,259} = 2.32$ ,  $P < 0.10$ ), the samples from the two fish springs taken together have a significantly lower  $b$  value (0.627) than that (0.776) of the samples from the two fishless springs taken together ( $t = 2.21$ ,  $df = 263$ ,  $P < 0.05$ ). This difference may be explained by hypothetical differences in the ontogenetic timing and magnitude of growth between populations in fish vs. fishless springs. This hypothesis is currently being tested by comparisons of metabolic scaling in additional fish and fishless springs, and by field and laboratory studies of growth in our study populations.

### **4. Trophic ecology of salamanders within riparian habitats**

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Semi-aquatic salamanders may have a considerable impact on forest-floor invertebrate communities and, consequently, leaf-litter decomposition rates. I am investigating the impact of semi-aquatic salamanders on invertebrate community structure and decomposition rates within forested riparian zones of low-order streams. This study will be accomplished through three concurrent projects: (1) determination of the diet of three locally abundant salamander species; (2) a field enclosure experiment to determine the effect of salamanders on invertebrate community structure and leaf-litter decomposition rates; and (3) a laboratory experiment to determine the relative importance of specific

trophic pathways that influence how invertebrate communities respond to the presence of salamanders. Stomach content data support the assumption that semi-aquatic salamanders feed within the forest floor and that they feed at numerous trophic levels. Completion of this study will shed light on the role of salamanders in the ecosystem and allow us to better understand food webs in general.

### **5. Circadian temperature patterns inside webs of the fall webworm, *Hyphantria cunea* (Lepidoptera: Arctiidae): importance of weather and directional orientation in tree canopies**

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Fall webworms (*Hyphantria cunea*, Lepidoptera: Arctiidae) live in large aggregations inside silk webs in trees. The benefits of living in a web probably include warmer daytime body temperatures. I measured temperatures inside 35 webs and compared them to nearby full-sun and full-shade temperatures every 15 min for 4-6 days. On average, web interiors had fluctuating temperatures that were above ambient (shade) for 7 or more hours per day. The time of day that webs showed peak temperatures depended on their specific orientation relative to the sun's path. Some webs showed peak temperatures before 0900 h whereas other webs peaked after 1700 h. Web locations on the perimeter of tree canopies showed no directional bias towards south or any other direction (n=53 webs). This was surprising because south-facing webs were, on average, warmer than north-facing webs. Web temperatures did correlate with weather conditions. On sunny days, web temperatures were 3 – 16° C warmer than ambient for about 7 h (n=8). Those same webs, on overcast and rainy days, showed no capacity to trap and hold heat. Although webworms cannot physiologically elevate body temperature, they clearly do create living spaces that efficiently capture environmental heat.

### **C. Plant/Animal Interactions**

#### **6. Are overabundant deer in a Pennsylvania wildlife preserve eating all the tree seeds?**

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Previous studies in a wildlife preserve where hunting is prohibited demonstrated that overabundant white-tailed deer (*Odocoileus virginianus* Zimmerman) have virtually eliminated tree seedlings and saplings. Our experiments seek to determine which animals are responsible for tree seed predation. Our four treatments are (1) protection of seeds from deer and rodents (wood and wire mesh enclosures), (2) protection from deer (identical enclosures with 8.5 cm diameter openings allowing rodent access), (3) no protection (enclosures with a completely open top), and (4) no protection (seeds on bare ground). The treatments are replicated three times at each of three locations with seeds of two tree species: mockernut hickory (*Carya tomentosa* [Poir.] Nutt.) and red oak (*Quercus rubra*. L.). We hypothesized that (1) deer are responsible for the majority of seed predation, and (2) seed predation by deer increases with proximity to a mowed field where deer often feed. We are now collecting our second year of data. The first year's results indicated that predation rates for unprotected seeds were double those for seeds protected from deer but not rodents (0.60 seeds/day vs. 0.32 seeds/day). This suggests

that deer and rodents are each responsible for approximately half of the seed predation. The second year's, preliminary results indicate that seed predation rates for unprotected seeds are the same as for seeds protected from deer but not rodents (5.8 seeds/day). This suggests that rodents are responsible for all seed predation. We have not seen a relationship between seed proximity to the mowed field and predation rate.

#### **D. Animal Behavior**

##### **7. Effects of cover objects and chemical cues of a specialist predator on the predator avoidance response of red-backed salamanders**

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Previous studies with plethodontid salamanders have shown an avoidance response to the chemical cues of potential predators. Modification of behavior in red-backed salamanders (*Plethodon cinereus*) due to predation may lead to decreased foraging efforts, which in turn could impact their role within detrital food webs. However, previous studies have been conducted in simple laboratory environments that may not represent the choices and challenges provided in nature. Specifically, more complex environments may offer additional choices for salamanders, e.g., avoiding predators vs. choosing cover objects; and specialist predators, e.g., the ring-neck snake (*Diadophis punctatus*), may elicit differential responses among salamanders in comparison to more general predators. Therefore, we measured the response of red-backed salamanders to the chemical cues of *D. punctatus* in laboratory microcosms that offer salamanders simultaneous choices of avoiding predator cues and seeking cover objects. Experiments were carried out in microcosms containing soil, leaf litter, and in some cases, ceramic tiles serving as cover objects. We hypothesized that the salamanders would demonstrate an avoidance of the snake cues and a preference for cover objects away from the cues. Overall, We found that red-backed salamanders showed a significant level of avoidance to the chemical cues of *D. punctatus*, but avoidance was apparently unaffected by the presence of cover objects.

##### **8. Spatial ecology of the timber rattlesnake at the Warren Grove Gunnery Range, Burlington County, New Jersey**

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The timber rattlesnake (*Crotalus horridus*) is a state endangered species in the Pinelands of southern New Jersey. The Warren Grove Gunnery Range (WGR), located in Burlington County, New Jersey, occupies 9400 acres of upland pine-oak forests, wetlands, and disturbed sites as a result of military operations. Key objectives of the study were to estimate population size, monitor home range movements, determine habitat preference, locate areas of high use and record locations of hibernacula to determine if military operations impacted this newly discovered population. During this study, we pit-tagged 24 individuals and monitored the home range and movements of 3 female and 6 male radio-implanted timber rattlesnakes. Sixty seven percent of relocations were in wetlands and 30% were in uplands. All of the upland relocations were within 75 meters of wetland habitats. Male snakes had larger home ranges (89 ha) than females

(60.5 ha), including larger core areas, 26 ha and 9 ha respectively. Disturbed habitats (i.e. open fields) accounted for 27% of upland relocations. Most disturbed sites were located within core areas where disturbance provided good habitat for foraging, basking, and brooding of gravid females. Military operations did not impact the timber rattlesnake population. A better understanding of the spatial ecology of the timber rattlesnake at WGR will help natural resource managers to protect this state endangered species and to maintain military readiness. As a result of this research, a conservation plan has been proposed at WGR that includes protection of large contiguous critical habitat and important use areas from potential impacts from road maintenance, prescribed burning, gravel extraction, and related military operations.

## **E. Aquatic Ecology**

### **9. Hyporheic exchange: the influence of aquifer heterogeneity and stream morphology**

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Hyporheic zones are important in the biogeochemical aspects of stream ecosystems. Groundwater modeling was used in this investigation to quantify the influence of geomorphic features and head gradients in the exchange process between surface and groundwater. Two and three-dimensional models were built with MODFLOW and the heterogeneity of aquifers was created with Turning Bands. Horizontally stratified anisotropic random fields were generated (ln K 0.25, 1.0, 2.5, 4.0). Aquifer interactions with straight and meandering streams were simulated. Channel morphology is part of the study since natural streams support healthy aquatic ecosystems due to habitat complexity. A sine curve was adopted as the path for meandering streams. Both models consist of a 180x256x360 (x, y, z) grid being the 2-D model 1m deep. The 3-D model has 16 layers for that depth. The river was simulated by constant-head cells. Modeling results show that as the degree of heterogeneity increases so does the volume of water interchanged. Flow variance increases as the lnK variance increases. It decreases for meandering streams when compared to straight-rivers. At transverse cross-sections it is reduced for a given heterogeneity pattern. Hyporheic exchange residence time distributions were determined by particle tracking using MODPATH. The results show that both aspects of the process interact to control water fluxes across channel boundaries and subsurface flow paths.

### **10. Macro-invertebrates, landuse and chemistry in an urbanizing watershed**

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In the NJ Pine Barrens, landuse, water chemistry and aquatic biota are changing as urban development encroaches. The watershed of Babcock Creek, in Atlantic County, presents an opportunity to study four tributaries, each of which has been affected in different ways by changing landuse. Adams Branch is highly urbanized. It has the highest pH and the stream channel carries a heavy load of sediment. Jack Pudding Branch has the most agriculture and the second highest pH. Babcock Creek is the least disturbed. Mankiller

Branch shows chemical alteration (its specific conductance as much as four times higher than Babcock Creek) possibly from highway runoff. Prior studies have shown that the macroinvertebrate fauna of woody debris (submerged sticks 3-35 mm in diameter) provides a readily sampled assemblage for biological monitoring in pinelands streams. We collected replicated stick samples at nine sites during three seasons over two years, along with detailed water chemistry data and landuse/land cover for each watershed. Results were analyzed using multivariate statistics and GIS. Adams branch is generally the most impoverished; flash flooding and shifting sediments may be responsible. Mankiller branch also showed very low invertebrate numbers. Both these streams lacked Trichoptera, Plecoptera and Ephemeroptera and had elevated numbers of oligochaeta, compared to Babcock Creek. Jack Pudding Branch had low numbers of all taxa studied; agricultural nutrients may be responsible. Our results indicate that the macro-invertebrate assemblage on woody debris responds differently to each of the suspected impacts.

### **11. Using RHESSys eco-hydrological model to examine the affect of riparian buffer zone width and placement on nitrogen loading in the Coweeta LTER**

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Riparian buffer zones have been shown to improve water quality in agricultural and urban environments, and their creation or restoration has been mandated in many areas by local government agencies. However, there is great dispute as to the required width of the buffer zone. Several processes contribute to poor water quality such as nitrogen, phosphorus, and sediment loading, and each of these processes may be affected differently by buffer width. This study uses the eco-hydrology modeling program RHESSys to study the relationship between buffer width and placement on nitrogen loading. We used watershed 18 of Coweeta LTER in its undisturbed state to model baseline nitrogen movement. We then used RHESSys to redefine the watershed as an suburban environment, and track nitrogen as it flows through the system, identifying key areas of denitrification and nitrification. We found that buffer size does affect NO<sub>3</sub> retention. The riparian zone is an area of denitrification, vegetative N uptake, and water retention. Buffers 10m wide or less on streams draining 0.5 ha do relatively little to slow discharge or retain nitrogen. The sources of the streams appear to be important locations for denitrification and N uptake. This may be because, in these areas, the soils are saturated; yet, the water is moving slowly, allowing more time for denitrification to occur. Further studies are needed to determine whether travel length of nitrogen or bulk area of buffer zone is the determining factor in total N retention.

### **F. Bio-Geochemistry**

### **12. Soil erosion rates measured on the Little Conestoga Creek Watershed, Pennsylvania**

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Recent analysis by the U.S. Geological Survey has shown that streams draining the Conestoga River Basin, PA have high sediment yields. Studies are underway to

determine sediment source areas in selected subbasins of the Conestoga River. As part of this effort, soil erosion rates were measured in the Little Conestoga Creek Watershed near Lancaster, PA. Soil profile samples were collected in 2004 from five agricultural fields in the watershed along transects parallel to the slope direction. Cesium-137 (Cs-137) concentration was determined for each sample. Walling and He developed models to determine erosion rates and patterns based on the concentration of Cs-137 measured in soil profiles. Their Mass Balance 2 model was used to calculate soil erosion rates based on Cs-137 measurements. Erosion/deposition rates ranged from  $-37.9$  to  $+0.4$  t/ha/yr, with negative values representing erosion sites and positive values being deposition sites. The average was  $-16.1$  t/ha/yr for the 51 sites in the 5 agricultural fields. This is greater than the 12 t/ha/yr that is considered the soil loss tolerance rate for this region. Sites at the toe of the slope or the bottom of the slope generally had less soil loss than samples on the slope or top of the slope.

## **G. Urban Ecology**

### **13. The role of aquatic macrophytes and riparian vegetation in ecosystem health of the Cuyahoga River Watershed in Northeast Ohio**

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We surveyed aquatic macrophyte diversity at 32 sites along an urban to rural gradient in the Cuyahoga River watershed in Northeast Ohio. We collected data on the physical features of the stream and quantified aquatic macrophyte abundance and a Qualitative Habitat Evaluation Index (QHEI). To characterize riparian zone, we quantified canopy coverage, species composition, land cover, tree diameter at breast height, and presence of invasive species along six 50m transects set perpendicular to the stream. Major human impacts, including roads and built structures, were also identified within each transect. Macrophytes were found at ten of the 32 sites, with an overall richness of 11 species among all sites. The most common aquatic macrophytes were: *Elodea canadensis*, *Sparganium americanum*, and *Sagittaria latifolia*. Physical stream characteristics were found to be strong indicators of fish population integrity, but not necessarily for aquatic macrophyte assemblages. Preliminary analysis indicates that invasive understory plants dominated riparian zones at a number of highly urbanized sites. Invasive species such as *Rosa multiflora*, *Alliaria petiolata*, and *Polygonum cuspidatum* were observed most frequently. Species composition was also found to be different in more disturbed urban habitats compared to relatively less disturbed rural sites. The extent to which riparian plant community composition reflects physical effects of urban stressors will be discussed. Results of this study will serve as the first comprehensive report of aquatic macrophytes and riparian vegetation in the Cuyahoga River watershed in Northeast Ohio.

### **14. RNA analysis of the blacknose dace (*Rhinichthys atratulus*): urban and rural populations**

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The blacknose dace (*Rhinichthys atratulus*), a stream minnow that persists in highly urbanized areas of Baltimore, Maryland, is the focus of a collaborative project that investigates the effects of watershed urbanization on the blacknose dace. The broad goal is to investigate the relative roles of phenotypic plasticity and rapid evolution in producing the differences observed in urban populations. The differences between the populations are that Herring Run dace mature sexually at 1 year vs. 2 years, are larger at age 1, and have an increased swimming endurance when compared to Beaver Run dace. If phenotypic plasticity is occurring between these isolated sites the fish will have differentially expressed genes due to the environmental changes. If rapid evolution is occurring then there will be uniquely expressed genes found within the two populations. Specifically, looking for differences in gene expression levels for specimens collected at different sample sites ranging from Beaver Run a rural site (1.8% impervious surface) to Herring Run an urban site (23% impervious surface). Total RNA was extracted from 11 fish from each population. Formaldehyde gels were run to determine the integrity of the extracted RNA. Differential display analysis identified several distinct gene expression differences between the populations ranging from differential expression to unique expression. Ultimately, determining which genes are expressed differentially in the two populations may provide a better understanding of the genetic differences behind the physiological and developmental differences observed along the urban-rural gradient.

#### **15. Soil respiration contribution to urban carbon dynamics at Cub Hill in response to global change**

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Soil respiration is the second largest factor in the flux of carbon between the Earth's ecosystems and the atmosphere and is one of the most frequently used indicators for measuring soil biological activity. To determine how much carbon is exchanged between an urban forest and the atmosphere, the microbial activity and carbon concentration (CO<sub>2</sub>) were measured in the forest floor of a suburban forest. CO<sub>2</sub> data suggest that the fraction of carbon that is being "lost" may be attributed to the reduction of soil microbial activity during the winter months. Significant differences in soil temperature were observed. On average, soil temperature decreased from a high of 21 °C to a low of 6°C. Soil moisture increased as a result of hurricane activity in August. An inverse correlation (-0.75, P < 0.0001) indicated that as soil moisture increased, soil temperature decreased. Similar results were also observed with the change in seasonal patterns in early autumn (-0.61, P < 0.001) as soil moisture increased, soil temperature decreased as a result of the loss of the canopy cover. As the temperature declined in October, soil microbial activity was reduced by 36%. Current data have not show what other factors may be related to below canopy soil respiration at Cub Hill. Further investigation is required. We expect to improve our understanding of soil respiration that will lead to the development of better models of carbon dynamics in urban forest ecosystems, which may in turn, lead to more reliable predictions of how forest patches will respond to global change.

## **16. Determination of spatial patterns of sediment storage and transport in Valley Creek, Valley Forge National Historical Park**

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Over the past several decades, urbanization has altered the hydrologic regime of Valley Creek, a tributary of the Schuylkill River west of Philadelphia. The increased peak flows have resulted in an increased flux of sediment through the 2.3 mile portion of Valley Creek that runs through Valley Forge National Historical Park (VFNHP), directly upstream of the Schuylkill confluence. We have divided the channel into 12 sediment transport and storage reaches, based on an extensive channel characterization. Within each of these reaches, 3 cross-sections have been installed and surveyed with a Sokkia SET510 total station. Bank tops and bottoms of several noteworthy erosion locations have also been surveyed to determine the amount of sediment entering the system due to channel instability. These bank lines and cross-sections continue to be resurveyed after significant storm events, one of which included the second highest discharge on record for Valley Creek. In addition to these surveys, several methods have been implemented along each cross-section to determine the spatial pattern of particle-size distributions, and the depth of the mobile layer. Continued work is in progress to monitor suspended sediment concentrations entering across the park boundary, as well as sediment particle sizes mobilized as a function of discharge. These evaluations will determine whether the dominant sediment input is from bank erosion within VFNHP or from upstream sources. We will also determine the spatial pattern of sediment transport and storage, and the resulting channel morphology of the portion of Valley Creek that runs through VFNHP.

## **17. The suburban landscape: patterns and processes in the soil**

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Urban sprawl is the major form of land use change today. We have been assessing soil characteristics, biodiversity and biogeochemical processes in a residential area northeast of Baltimore. This suburban landscape is extremely heterogeneous and includes a remnant forest patch, and a mix of high, medium and low density residential housing. A comparison of lawn and forest soils revealed that concentrations of P, K, and Mg were up to 50% higher in lawn than in forested areas. Forest soils also had higher contents of organic matter (10.0 vs. 7.5 g kg<sup>-1</sup>). Subdivisions also had differences with P concentrations and organic matter contents being significantly greater in the older of two subdivisions. Soil invertebrates varied by cover with earthworm density being generally higher in lawns (123 ind m<sup>-2</sup>), than in the forest patch (92 ind m<sup>-2</sup>). Biomass was about equal only in summer when the Asian invasive *Amyntas* reached its population peak. All but one of the twelve species found were non-native. *Lumbricus rubellus* and *L. terrestris* dominated the fauna. Both springtails and mites were most abundant (2505 and 28900 ind m<sup>-2</sup>) in the highly maintained lawns. Nitrogen mineralization was 150% and 26 % higher in the forest than on the lawn on a soil dry weight and an ash-free dry weight basis, respectively. However, local variation within land cover type was considerable in both soil fauna abundance and in N-cycling. From these results we conclude that fine scale heterogeneity has to be considered when evaluating suburban landscape processes.

### **18. Monitoring the subterranean urban realm: watershed 263 storm water sampling and flow measurement**

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The hydrology of two small headwater storm drain catchments in Watershed 263 are being studied in a long-term project of the Baltimore LTER focused on detecting changes in water quality and quantity before and after a major watershed restoration effort. Temperature, level and velocity is recorded and automated samplers suspended in manholes collect flow paced composite samples on a storm event basis. A USFS/DPW/CUERE crew retrieves samples, with aliquots distributed to labs at DPW, USDA ARS, UMBC, and IES for analysis of nutrients, solids, metals, bacteria, etc. Weekly visits provide for equipment maintenance and calibration, data downloads, and dry weather flow grab samples. Tight quarters and an unforgiving environment, with its high storm velocities, surcharges, and debris accumulation make data collection and sampling a challenging task, requiring a minimum of weekly maintenance to insure consistent, accurate data. Maintaining the stage-discharge rating is especially time consuming, due to the accumulation of debris and subsequent need for annotation of flow records. We describe the technical requirements and challenges associated with storm runoff sampling in highly urban areas.

### **19. Landscape level airborne mercury deposition in the Shenandoah Valley, VA II: replication in time**

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There is significant inorganic Hg contamination at Waynesboro, VA in the South River and on its floodplain. This resulted from industrial contamination in the early 1900s. The purpose of this study was to establish an extensive airborne Hg deposition sample grid with 125 sites in Waynesboro, VA, and compare Hg concentration data with 25 sites in Harrisonburg, and Staunton, VA; cities, which are removed geographically from the South River. There have been three repeated collections at these sampling sites during different time intervals in 2003 and 2004. Even though the data are expressed in  $\mu\text{g Hg}\cdot\text{m}^{-1}\cdot\text{mo}^{-1}$ , there is no reasonable expectation that the absolute concentrations would be the same for different total exposure or seasonally different time intervals. Therefore, a grand mean flux was obtained for each experiment and individual sites were characterized by the fraction of standard deviations from the grand means. Those sites that were consistently high are identified by this survey technique as ones of interest for future examination. The inexpensive plastic Petri plate samplers used in this study have potential as a landscape level screening technique for Hg and other airborne pollutants. Care must be taken in the interpretation of these measures of Hg because vapor, dissolved, particulate and organically bound Hg in insects and plant fragments all contribute to the gross sample. Therefore, the concentrations used in these studies are

best thought of as indexes of contamination analogous to using coliform bacteria as an index of fecal matter presence in aquatic systems.

## **20. Landscape level airborne mercury deposition in the Shenandoah Valley, VA III: using inexpensive passive samplers for landscape level screening**

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The presence of background levels of airborne Hg and non random local distributions within the cities of Waynesboro and Harrisonburg VA was detected when low cost plastic Petri plate passive samplers with a sticky “tangletrap<sup>®</sup>” gum surface exposed were attached to telephone poles for periods of three months or greater. The dust, insects, and other debris was digested (HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>) along with the gum and analyzed for Hg using cold vapor atomic absorption spectrophotometry with a Perkin Elmer FIMS. Hg deposition is expressed as  $\mu\text{g Hg}\cdot\text{m}^{-2}\cdot\text{mo}^{-1}$ . The patterns of high and low deposition rates within the landscape were mapped and an expected region of high air borne deposition was detected downstream from a known point source of Hg along the South River in Waynesboro, VA. Sites with high Hg deposition did not occur in Stuanton, VA, which served as a background “control” location, but several sites in Harrisonburg had deposition comparable to that in Waynesboro. There are numerous potential sources including a cogeneration waste disposal steam facility, unidentified industry and possibly residues from the use of mercurial fungicides on apple orchards surrounding the city in the 1900’s. A network of 50 sites was added to the original 25 Harrisonburg sampler pairs in surrounding northern Rockingham Co., VA, resulting in 75 sites with replicate samplers. Locations of interest have been identified for more extensive future sampling that will be used for further hypothesis testing.

## **21. Relative impacts of urban development in the buffer zone and ridge area on stream nitrate loads**

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Percent impervious surface area is highly correlated with increased runoff rates and water quality impairment. However, there is little assessment of how the location and distribution of impervious surface impacts runoff rates. It is typically assumed that land use has the greatest impact on watershed hydrology near streams, and hydrologic impacts beyond the riparian zone are proportional to the amount of disturbed watershed. Using the Regional Hydro-Ecologic Simulation System (RHESys), four exaggerated land development scenarios were simulated in two watersheds to determine the relative impacts of urban development in the ridge area and buffer zone on stream nitrate loads. The simulation was operated using data collected from the Coweeta LTER in Otto, NC, and the Baltimore LTER. Results indicate that paving the ridge area of these watersheds contributes more runoff under high stream-flow conditions than paving the buffer zone. During low-flow conditions, impervious surface in the buffer zone results in higher runoff production than paving the ridge area. In addition, land cover location was found to have a greater impact on runoff rates and nitrate loads than percent impervious surface area during high-flow conditions. These counterintuitive effects associated with ridge

area development create a riparian bypass mechanism at high-flow, possibly suppressing the role of riparian buffers in nutrient retention.

## **H. Invasive Species**

### **22. What makes invasions happen? Environmental Variation, Survival and Reproduction in *Alliaria petiolata*.**

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Information about how plants respond to seasonally changing resources enables us to understand patterns of population growth. This is important for understanding the success of exotic invasive species such as *Alliaria petiolata*. Growth, survival and fecundity of *A. petiolata* was observed in 40 permanent field study plots along with N availability and pH to determine how these abiotic factors influence the first year of the life cycle (seeds to seedlings) of *A. petiolata*. Increased availability of  $\text{NH}_4^+$  increased leaf number and leaf number influenced % survival. Soil pH and  $\text{NO}_3^-$  availability influenced seed and silique quantity per plant. However, there was no relationship between  $\text{NO}_3^-$ ,  $\text{NH}_4^+$  and pH.

### **23. Invasive terrestrial isopods and soil nutrient cycling**

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Invasive species such as terrestrial isopods can profoundly affect the functioning of ecosystems. The terrestrial isopod species researched in this study- *Armadillidium nasatum*, *Cylisticus convexus*, *Oniscus asellus*, *Porcellio dilatatus*, *P. scaber*, *Trachelipus rathkei*- are detritivores that can reach high population densities in Mid-Atlantic forests. The isopods were fed on three different leaf types - beech (*Fagus grandifolia*), oak (a mixture of *Quercus rubra* and *velutina*), and tulip poplar (*Liriodendron tulipifera*)- for 1 month to investigate how the leaf types affect the growth rate of the isopods and how the different isopods feeding on the different litters affect soil organic matter content and microbial activity. Consumption rates were greatest for oak, which averaged 77.7 mg leaf/g animal/day. The beech average was 51.7 mg leaf/g animal/day and the tulip poplar averaged 54.7 mg leaf/animal/day. Isopod feeding increased soil organic matter content from an average of 5.25% (controls- microbial activity) to an average of 8.2% in the beech trials, 11.3% in the oak trials, and 9.9% in the tulip poplar trials. Change in soil inorganic nitrogen content as a result of isopod feeding on the different litters was also measured.

### **24. Positive feedback on *Ailanthus altissima*: a generalized response?**

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A recent explanation for the ability of exotic plant species to invade novel habitats is the 'novel weapons' hypothesis. This hypothesis postulates that species introduced into new habitats release biochemicals into the soil that are novel to community members in the new habitat. Novel biochemicals may alter soil microbe communities to the benefit of the introduced species (positive feedback). In this study, seeds of *Ailanthus altissima*, a

reported allelopathic tree, were germinated and grown in a sterile soil mix inoculated with soil previously occupied by either *A. altissima* or one of 3 other early successional tree species: Yellow Poplar (*Liriodendron tulipifera*), Black Locust (*Robinia pseudoacacia*), and Red Maple (*Acer rubrum*). The effect of pre-culturing the soil on the biomass of *A. altissima* was positive for all tree species tested compared to pre-cultured soil that was sterilized. These results suggest that a positive feedback effect on *A. altissima* may not be due to a species specific alteration of the soil biota, but a more generalized response.

## **25. The effect of four early-successional Pennsylvania tree species on soil bacterial communities.**

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The role of microbial communities on the above ground plant species composition has been well documented. However, little research has been done on the effect of plants on the microbial community below ground, particularly bacterial communities. Previous work has been conducted in the field, therefore preventing the comparison of each plant species' microbial community. To examine only the effects of a specific tree on the bacterial community, trees were planted in separate pots with a soil mix (2:2:1, sterile soil, peat, sterile perlite). The trees used were Yellow Poplar (*Liriodendron tulipifera*), Black Locust (*Robinia pseudoacacia*), Tree of Heaven (*Ailanthus altissima*), and Red Maple (*Acer rubrum*). Soil extracts were used to inoculate gram negative and ecolog microtiter plate and agar plates. Black Locust and Tree of Heaven had greater functional diversity and functional richness when compared to the control. Yellow Poplar's bacterial community strongly resembled the control pot's bacterial community. Heterotrophic counts corroborated with the results from the gram negative and ecolog microtiter plates.

## **I. Management/Applied Ecology**

### **26. The association of beaver (*Castor canadensis*) with the presence of *Giardia* in a small reservoir**

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The North American beaver, *Castor canadensis*, is a known carrier of *Giardia*, a common intestinal parasite. Since *Giardia* can be shed in feces, a waterbody inhabited by an infected beaver may pose a hazard to humans. Sweet Briar College, located in the foothills of the Blue Ridge Mountains in Virginia, has two reservoirs, one of which is the site of an active beaver lodge. Since there has been circumstantial evidence suggesting that *Giardia* may be in the lake due to the presence of beavers, some lake management options included beaver removal. This investigation used ArcGIS to make a record of active lodges, beaver dams, and other beaver activity. Water samples were taken from three sites: the active lodge, the beaver dam, and the lake impoundment. Approximately 10 L samples were filtered and analyzed for the presence of *Giardia* using the Meriflour immunoassay procedure, which is a fluorescence antibody technique. In addition, deer, geese, and bobcat scat were analyzed for *Giardia* using direct immunofluorescence. The

data acquired do not support the hypothesis that beaver are correlated with suspected gastrointestinal disease at Sweet Briar Lake. The influence of other species is being investigated. Lake management plans must include site specific data in order to render a final decision concerning the removal of beavers from reservoirs.

### **27. A comparison of soil chemical characteristics: urban and rural gradients of Baltimore and New York, and cities of Baltimore and Budapest**

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Soils located in metropolitan areas are known to be contaminated by heavy metals. We investigated the effects of urbanization on soil chemical characteristics. To determine the impact of atmospheric deposition, we looked at urban-rural gradients in two cities: Baltimore and New York. Calcium concentration decreased in forest soils from the urban center of both New York and Baltimore (100-200 mg kg<sup>-1</sup>) to the rural areas (<50 mg kg<sup>-1</sup>). Copper, nickel, and lead decreased in content (kg ha<sup>-1</sup>) in forest soils from the urban center of New York to the rural areas. To determine the impact of parent material, we analyzed soil characteristics from two cities, Baltimore and Budapest, that have two different parent materials within their city borders. The similar metals and nutrients that were significantly different (p<0.05) between the two types of parent material for Baltimore and the two types of parent material for Budapest were Al, Co, Cr, Fe, Mg, Mn, Ni, and V. Finally, to determine the impact of vegetation structure, we investigated soil characteristics under two different cover types: forest and grass. The metals and nutrients that were significantly different (p<0.05) for both Baltimore and Budapest were Ca, P, and Zn. Therefore, regional patterns of some heavy metal concentrations can be explained by geochemical properties of mineral soil and parent material, and atmospheric deposition. Furthermore, cover type/management may influence the concentration of some elements.

### **28. The Watershed 263 small headwater storm drains: restoration of an urban catchment's hydrology**

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The hydrology of two highly urban small headwater storm drain catchments in *Watershed 263* (Baltimore, MD) is being studied with continuous temperature recorders, stage and velocity gauges, and automated flow paced samplers. This long-term study (part of the BES LTER) is measuring changes in runoff flows and quality coincident with the introduction of various vegetation, structural and operational BMPs (best management practices). It is also examining source areas and the utility of high resolution hydrologic and ecological models in evaluating BMP effectiveness over time. We present preliminary dry weather and stormflow data that reveal a dynamic, complex hydrologic system with high BOD, bacterial, nutrient and metal concentrations. Even though there are no known sewage connections, bacterial storm concentrations approached those of raw sewage, indicating the presence of significant animal sources within the impervious areas of the landscape. These underground streams exhibited temperature variances,

nutrient concentrations and fluoride levels which suggest that both surface and groundwater hydrologic interactions are important. Any attempts at decreasing catchment material and water fluxes will require the consideration of a complex system of civil hydro-infrastructure, social dynamics and the degree of hydrologic connectivity between soils, vegetation and impervious surfaces on the landscape.

### **29. Using model urban and suburban landscapes to determine non-point source pollution potential**

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The contribution of urban and suburban land to non-point source pollution is thought considerable. Little is known about how land covers of different vegetation representative of suburban areas (e.g. bare soil, turfgrass lawn, mulched beds, forest) influence the potential for stormwater runoff and non-point source pollution. Rainfall was manipulated on sloped plots with landscape covers of bare soil, shredded wood mulch, fescue-blend turfgrass, and simulated urban forest. Runoff was collected and analyzed for volume and sediment mass. The data obtained were used to quantify the influence of land cover type and precipitation level on volume and quality parameters of runoff and sediment and nutrient loading. Preliminary results indicate the turfgrass treatment reduces water and sediment runoff more than the other landscape treatments considered here. Measurements of nitrogen and phosphorous levels in runoff was also collected and will provide more complete information to better inform land use policy and best management practices of the influences of urban landscapes on water quality.

## **J. Ecology Education**

### **30. Success of the Maryland breeding bird atlas project at Cecil Community College**

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The purpose of this project was to take on the responsibility of independent research sites as part of our participation in on-going research for the 2002-2006 Maryland/District of Columbia Breeding Bird Atlas. As novice students in ornithological studies, as well as field research, our primary objective was to learn the skills of species identification and breeding bird behavior. Due to our relative inexperience, an unconventional approach of integrating various methods of identification was applied with surprising results. A total number of 67 species were observed, with 36 confirmed, 11 probable, and 20 possible nesters. Photographs of astonishing and unique findings include a hooded merganser and nest, a great blue heron rookery, and nests of an ovenbird, hooded warbler, turkey vulture, and pileated woodpecker with young.