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Roger Masse

Mid-Atlantic Chapter

MID-ATLANTIC ESTUARIES

ABSTRACTS

2013 Annual Conference
Mid-Atlantic Chapter
Ecological Society of America
April 13th & 14th, 2013

Hosted by Delaware State University
Dover, DE

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2013 Annual Conference
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Hosted by Delaware State University
Dover, DE 19904

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2013 MA-ESA General Meeting Schedule

	Atrium	Sauvignon Room	Siena Room	Venetian Room	Verona Room
8:00	Registration & Light Breakfast in Convention Lobby				
8:15					
8:30					
8:45					
9:00					
9:15	Opening Remarks				
9:30	Mid-morning break in Convention Lobby				
9:45					
10:00					
10:15					
10:30	Boxed Lunch in Chardonnay/Champagne Room <i>Business meeting will be held in Chops Grill Boardroom and Student business meeting will be in Chops East room Both are located in the hotel restaurant Chops.</i>				
10:45					
11:00					
11:15					
11:30	Plenary Talk: Mary Fabrizio, PhD "Effects of Hypoxia on Chesapeake Bay Fishes"				
11:45	Afternoon break in Convention Lobby				
12:00					
12:15					
12:30					
12:45					
13:00			Oral Session 1A: <i>Land Management & Urban Environments</i>	Oral Session 1B: <i>Mid-Atlantic Estuaries</i>	Oral Session 1C: <i>Ecological Potpourri</i>
13:15	Oral Session 2A: <i>Terrestrial Fauna</i>				
13:30					
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14:15	Oral Session 2B: <i>Mid-Atlantic Estuaries</i>				
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15:00					
15:15	Oral Session 2C: <i>Public Outreach & Science Education</i>				
15:30					
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16:00					
16:15	Poster Session & Cash Bar				
16:30					
16:45					
17:00					
17:15	Banquet: John Agnew "Ants in My Paints" & Student Presentation Awards				
17:30					
17:45					
18:00					
18:15	Student Outing: Fordham Brewing Company \$10 8:00p-9:30p ALL MEETING ATTENDEES WELCOME				
18:30					
18:45					
19:00					
19:15	St. Jones Reserve Field Trip Please join us on Sunday April 14th 8:30a-12:00p for a field trip to the St. Jones Reserve! The 3750 acre St. Jones Reserve stretches down a medium-salinity tidal river for 5.5 miles, where the river empties into the Delaware Bay. The reserve has a 2 mile hiking trail, with a ¼ mile boardwalk over salt marsh habitat. The reserve's buildings were sustainably designed with geothermal heating/cooling, a wetland-based tertiary wastewater system, and solar panels. The reserve also houses the Delaware Native Plant Society nursery and the Alvin G. Wilson Conservation Demonstration Area. There will be a guided tour and time to explore th reserve on your own. Drinks and snacks will be provided, and we will head to a local restaurant for lunch. Transportation will not be provided, but we will be carpooling. Maps to the reserve can be found in your registration packet. If you are interested in attending and have not signed up through email, please add your name to the list at the registration table. This event is free!				
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Speaker Biographies

Keynote Speaker John Agnew

John Agnew is an artist of the natural world. His career began in natural history museums, where he has designed exhibits, produced illustrations and painted murals and dioramas for museums and zoos around the country and as far away as Moscow. Since the early 80's, John has produced nearly thirty thousand square feet of murals and dioramas in the Cincinnati area for the Cincinnati Museum of Natural History and Science, the Cincinnati Zoo, Cincinnati Parks and Hamilton County Parks.

His smaller paintings of natural history subjects are in collections around the world. He is a Signature Member and a member of the Executive Board of the Society of Animal Artists, and a founding member of Masterworks for Nature. He has participated in major exhibitions of realist work, including Art and the Animal, Arts For the Parks, and Birds In Art. In 2007 he was the Grand Prize winner of the national juried show, "Paint the Parks" and received an Award of Excellence in the Society of Animal Artists annual show, "Art and the Animal." In 2009 he received the "Patricia A. Bott Award for Creative Excellence" at "Art and the Animal." In 2012, he received the Ronald David Smith Memorial Award at the Kentucky National Wildlife Art Exhibit. He has published many limited edition prints and in 2001, North Light Books published his book, "Painting the Secret World of Nature." His work has been featured in Artist's Magazine, Reptiles magazine and others.

In 2009 he was named Artist in Residence at Pictured Rocks National Lakeshore, and in 2011, he was named Artist in Residence at Everglades National Park. He has traveled worldwide in search of his subjects, including Borneo, Thailand and the Peruvian Amazon in addition to much of the United States.

He is represented by Miller Gallery in Cincinnati, Ohio and the Tang Gallery in Bisbee, Arizona.

Plenary Speaker Jeff Buler

Jeff holds a MS degree in wildlife from Louisiana State University and a PhD (2006) in biology from the University of Southern Mississippi where he studied the stopover ecology and distributions of migrating landbirds along the northern Gulf of Mexico under the direction of Frank Moore. After finishing his PhD, he joined the department of Entomology and Wildlife Ecology at the University of Delaware in 2007 as a research scientist and has been an Assistant Professor there since 2011. His research is primarily focused on the movement, behavior, and ecology of birds during migratory stopover and modeling bird species distributions. Jeff is one of a handful of biologists in the United States actively using the national network of weather surveillance radars to study the distribution, movement, and habitat use patterns of migratory birds. His radar research includes developing techniques to quantify bird distributions, assessing bird response to habitat management and restoration activities, identifying important stopover areas, and examining how migrating birds respond to extreme weather events and negotiate ecological barriers to migration.

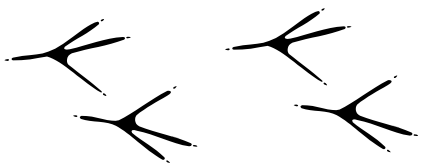
Plenary Speaker Mary C. Fabrizio

Mary received her PhD from the Graduate School of Oceanography at the University of Rhode Island. She served as adjunct faculty at Michigan State University in the Department of Fisheries & Wildlife until 2000 where she moved to work as chief of the Behavioral Ecology Branch of NOAA at the Northeast Fisheries Science Center in Highlands, NJ. Currently, Mary is an associate professor in the Department of Fisheries Science at the Virginia Institute of Marine Science. Her research focuses on recruitment dynamics of Chesapeake Bay fishes, spatial ecology of estuarine fishes, population dynamics of juvenile fishes, and sampling designs for fishery-independent surveys. Mary has mentored several graduate students, published many articles, served on boards for several organizations, and has been recognized for her hard work by awards from the American Fisheries Society and NOAA.

Oral Presentation Concurrent Session 1

Time	Session 1A: Land Mgmt & Urban Environments (Siena Room)	Session 1B: Mid-Atlantic Estuaries (Venetian Room)	Session 1C: Ecological Potpourri (Verona Room)
1:30	<p>Urban habitats: Attractive, but bad for nature? On fruits, metals, and birds</p> <p><i>Megan Litwhiler, Rutgers University</i></p>	<p>Evaluation of tidal marsh production, functions, and values in an urban estuary</p> <p><i>Jennifer Wollenberg, The ELM Group</i></p>	<p>Population origin and genome size do not impact <i>Panicum virgatum</i> (switchgrass) responses to variable precipitations</p> <p><i>Kimberly O'Keefe, Kansas State University</i></p>
1:45	<p>The influence of land management practices on the above and below ground mutualisms of the Pine Barren gentian (<i>Gentiana autumnalis</i>) in New Jersey</p> <p><i>Ryan Rebozo, Drexel University</i></p>	<p>The effect of water quality goals on submersed aquatic vegetation growth and ecosystem benefits in the Chesapeake Bay</p> <p><i>Hayley Tumas, UMD College Park</i></p>	<p>The role of carbohydrate metabolism and sugar signaling in elevated CO₂-induced altered flowering time of <i>Arabidopsis thaliana</i></p> <p><i>Leigh Ann Scholtz, St. Joseph's University</i></p>
2:00	<p>Dam removal impacts on biodiversity and abundance of invasive species</p> <p><i>Alan Griffith, U of Mary Washington</i></p>	<p>Evaluating the potential resiliency of <i>Vallisneria americana</i> in the Potomac River (USA) using individual-based networks of genetic distances</p> <p><i>Brittany West-Marsden, UMD College Park</i></p>	<p>Effects of inbreeding on floral volatiles in <i>Mimulus guttatus</i></p> <p><i>Ariela Haber, U of Virginia, Charlottesville</i></p>
2:15	<p>How not to protect streams and wetlands, Pennsylvania-style</p> <p><i>James Schmid, Schmid & Company, Inc.</i></p>	<p>Science Synthesis: Echohydrology and a new stormwater management paradigm</p> <p><i>Kenneth Belt, USDA, Forest Service</i></p>	<p>The effect of invasive species on soil characteristics and microbial communities at Powdermill Nature Reserve</p> <p><i>Linda Johnson, Chatham University</i></p>
2:30	<p>Intersex in blacknose dace from three small wastewater-influenced streams in south-central Pennsylvania</p> <p><i>Theo Light, Shippensburg University</i></p>		<p>The association between pea aphid defensive symbionts and fungal mortality under natural conditions</p> <p><i>Andrew Smith, Drexel University</i></p>

Oral Presentation Concurrent Session 2

Time	Session 2A: Terrestrial Fauna (Siena Room)	Session 2B: Mid-Atlantic Estuaries (Venetian Room)	Session 2C: Public Outreach & Science Education (Verona Room)
3:00	<p>Radio telemetry on the neonate ecology of the northern pine snake (<i>Pituophis melanoleucus</i>)</p> <p><i>Kevin Smith, Drexel University</i></p>	<p>Using Geographic Information System technology to spatially analyze the environmental conditions affecting nesting site selection of <i>Malaclemys terrapin</i></p> <p><i>Jamie Conley, Widener University</i></p>	<p>Birdies, eagles, and...bats? Unexpected public outreach opportunities for bat conservation on golf courses</p> <p><i>Megan Wallrichs, Delaware State University</i></p>
3:15	<p>The impact of caudal autotomy on growth in <i>Sceloporus jarrovii</i> (Phrynosomatidae)</p> <p><i>Christopher Agard, Howard University</i></p>	<p>Competition between red-bellied turtles (<i>Pseudemys rubriventris</i>) and invasive red-eared slider turtles (<i>Trachemys scripta elegans</i>)</p> <p><i>Steven Pearson, Drexel University</i></p>	<p>Synthesizing to teach ecology: Using ethnographic, socioeconomic, and environmental science data to teach undergraduates the actionable science and ethical responses to the challenges imposed upon Arctic nations by climate change</p> <p><i>Bruce Grant, Widener University</i></p>
3:30	<p>Population estimate of the northern pine snake in the New Jersey Pinelands</p> <p><i>Dane Ward, Drexel University.</i></p>	<p>Chesapeake Bay nutria eradication program overview</p> <p><i>Margaret Pepper, USDA</i></p>	<p>Innovative ecological education instructional strategy in an online environment</p> <p><i>Celine Santiago Bass, Kaplan University</i></p>
3:45	<p>Using DNA and microhistological analysis to examine competition of 2 sympatric cervids</p> <p><i>David Kalb, University of Delaware</i></p>		

#	<u>Poster Title</u>	<u>Presenter</u>
1	The impact of Japanese Knotweed on stream water content of the Peckman and Third Rivers, NJ	Guzner
2	Chronic water stress alters growth and physiology of American Beachgrass, <i>Ammophila breviligulata</i>	Picariello
3	Water stress alters growth and biomass allocation of five strains of American Beachgrass, <i>Ammophila breviligulata</i>	Araujo
4	Effects of methoprene and larvae on invasive mosquito reproduction	Groman
5	A stable isotopic and fatty acid food web comparison of Atlantic and Gulf menhaden	Dean
6	Investigating the impact of <i>Phragmites australis</i> on essential blue crab habitat in Blackbird Creek, Delaware	Roeske
7	Spring distribution and abundance of salamanders (Order Caudata) in the Mid-Atlantic region of the United States	Sheffield
8	Macroinvertebrate and chemical assessment of the water quality in Middle Spring Creek, Shippensburg, PA	Smith
9	Response of salamanders to legacy sediment removal at Big Spring Run, Lancaster, Pennsylvania	Payne
10	The effect of temperature change on the behavior of the northern pine snake and implications for climate change	D'Amelio
11	Impacts of historical milldams on habitat of the bog turtle (<i>Glyptemys muhlenbergii</i>), a federally listed species	Miller
12	The effects of substrate type on the behavior and movement of <i>Pituophis melanoleucus</i> , the northern pine snake	Marano
13	Perceptual landscape of suburban deer	Potapov
14	Does wind affect habitat choice of white-tailed deer?	Rodgers
15	A spatially and temporally concurrent comparison of popular deer abundance estimators	Haus
16	Hi-resolution mapping reveals interactive spatial distribution of multiflora rose, other shrubs and white-tailed deer in the Delaware River Estuary watershed	Atkins

- 17 Herbivory and plant defense mechanisms: Glucosinolate production response in two *Brassica* species Schmid
- 18 Herbivory response of *Murgantia histrionica* to a Ni-hyperaccumulator, *Alyssum murale* Johnson
- 19 The effects of an environmental enrichment device (EED) on the social and zoo-directed behaviors of captive Asian small-clawed otters (*Aonyx cinerea*) Duvall
- 20 Monitoring the population of big brown bats in White Clay Creek Preserve Madera
- 21 Investigating the seasonal dietary variation of big brown bats (*Eptesicus fuscus*) using DNA barcoding Sweitzer
- 22 Songbird use of a capped landfill as a migratory stopover site in the New Jersey Meadowlands Marchese
- 23 The effects of ocean acidification on the occurrence and severity of otolith deformities in the mummichog (*Fundulus heteroclitus*) Stoneman
- 24 Prediction of *Dreissena polymorpha* invasion in Maryland utilizing surface water characteristics and Maximum Entropy modeling Beebe
- 25 Should Pennsylvania use *E. coli* as its standard for determining recreational water quality? Blair
- 26 Defining the understory: refinements in hemispherical photography Brusa
- 27 A baseline study of the environmental attributes and the quantification of ecosystem services for DeShong Park in Chester, PA Carpenter
- 28 Characterization of soil microbes, White Clay Creek Preserve Abbott
- 29 Site and soil layer variation in the microbial populations of two urban forest remnants Kulka
- 30 Pea aphid defensive symbiont dynamics in response to parasitoid wasp Mayo

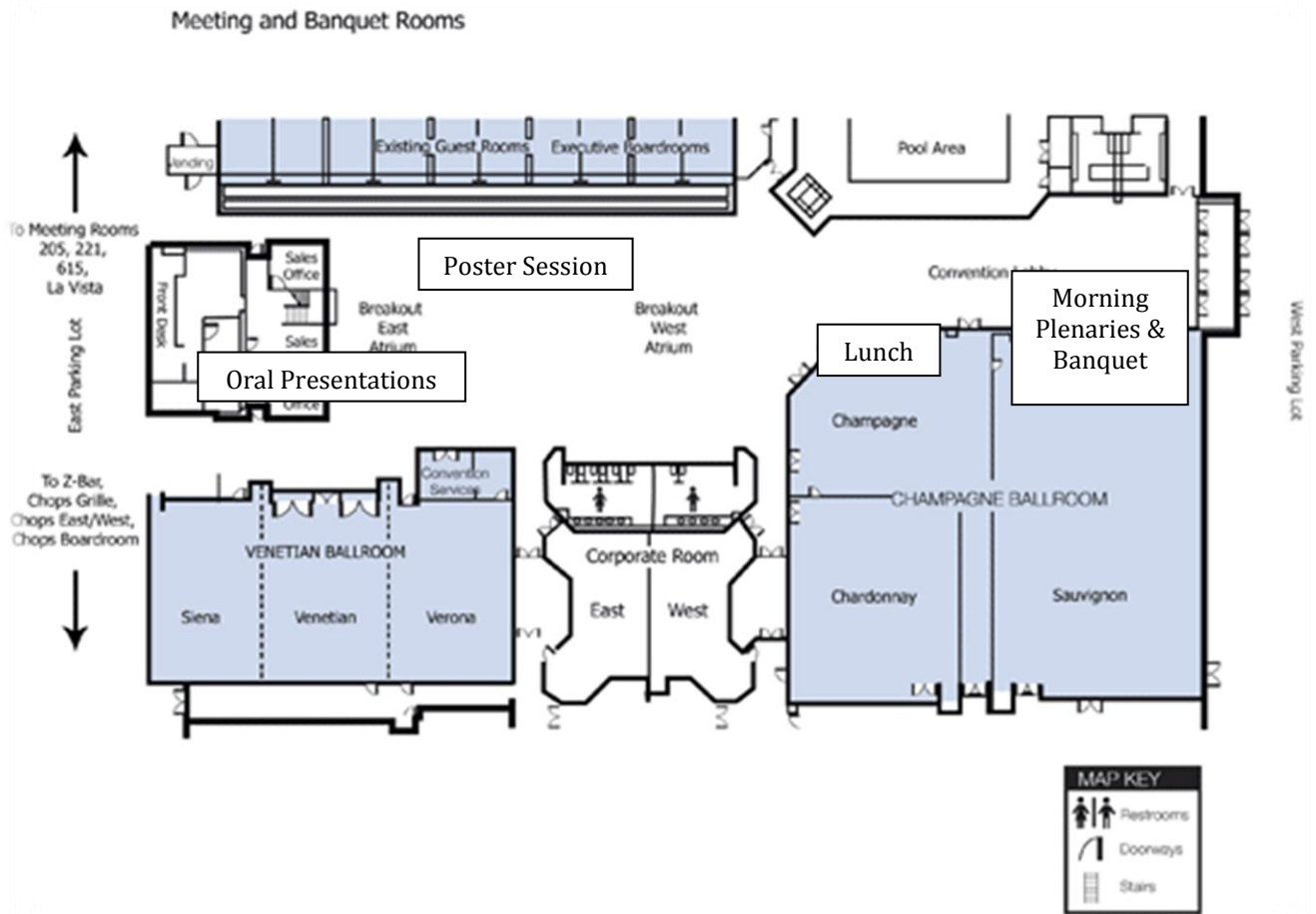
- 31 Pea aphid, *Acyrtosiphon pisum*, symbiont diversity over time and space *Messina*
- 32 Notes on the diversity and foraging height of the carrion beetles (Coleoptera: Silphidae) of the Nassawango Creek Preserve, Maryland, USA *Dyer*
- 33 Illustrated keys to the Scarabaeinae (dung beetles) of Maryland *Nemes*
- 34 Dung beetles and their gut endosymbionts *Hagadorn*
- 35 Native bees in the N.J. Pinelands: Diversity and habitat relations *Hamblin*
- 36 Comparison of genetic variation in healthy and diseased populations of the old-field grass *Andropogon virginicus* *Giacopelli*
- 37 Caterpillar host plant choice and parasitoid infection rates: An investigation in tri-trophic interactions *Tweitmann*
- 38 Assessment of IPM hub strategy on the Dickinson College Farm *Ramthun*
- 39 Evaluation of earthworm communities and the effects on forest diversity dynamics in southwestern Virginia *Wieboldt*
- 40 Invasion meltdown: Role of non-native species *Alliaria petiolata* and *Lumbricus terrestris* on native species dynamics *Lefevers*
- 41 Comparison of genetic variation in native and non-native populations of the grass *Andropogon virginicus* *Readinger*
- 42 Interactive effects of the invasive *Amyntas sp.* and *Alliaria petiolata* on native plant population dynamics *Sarbacher*
- 43 A novel defense? Understanding the plant competition role of the enzyme polyphenol oxidase in the invasive genus *Bromus* *Plank*
- 44 Comparing brownfield and old-field floras of New Jersey: Do non-native plants make up a higher proportion of brownfield floras? *Perzley*
- 45 *Arabidopsis* scaffold protein RACK1A regulates diverse environmental stress signaling pathways *Rogers*

- 46 Analyzing the spatial distribution of ash trees (*Fraxinus*) at the Bucks County Audubon Society's Honey Hollow conservation property to quantify the loss of ecosystem services by potential predation of the emerald ash borer (*A. planipennis*) *Ortiz*
- 47 Quantifying the changes in ecosystem services from a shade tree project in an urban park in Chester, PA from 2009 to 2013 *Ortiz*
- 48 Effects of water quality on catch per unit effort of juvenile lemon sharks, *Negaprion brevirostris* Poey, in the coastal waters *Breza*
- 49 Determining the effect of higher atmospheric [CO₂] on the symbiotic relationship of *Sinorhizobium meliloti* and alfalfa *Montemarano*

**The book of abstracts can be found at
www.esa.org/midatlantic2/
under the “Conference Resources” tab.**



Sheraton Hotel Meeting Rooms



If you have any questions please go to the registration table located in the Convention Lobby and we will be happy to help!

Session 1A: Land Management & Urban Environments (Siena Room)

Urban habitats – Attractive, but bad for nature?: On fruits, metals, and birds

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(2) Urban Forestry Program, 14 College Farm Rd., Rutgers University, New Brunswick, NJ 08901

(3) Department of Preventive Medicine and Community Health, Box 1709, UMDNJ – New Jersey Medical School, Newark, NJ 07101

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Urban habitats provide valuable refuge for wildlife; however, these sites are often polluted and may pose a greater risk than benefit to the species they attract. We examined attraction versus risk by investigating the trophic transfer of heavy metals and avian frugivory at a brownfield in Liberty State Park (LSP) in New Jersey. To map the trophic transfer of metals we determined the metal load for avian, invertebrate, and fruit samples from LSP and a control site. Little is known about the potential for metal transfer from fruits to birds. We aimed to determine which species of birds feed on which species of fruit at LSP and if frugivores are at risk for metal consumption. Field observations were conducted at ten individual plants from five fleshy-fruited species. We recorded the species and number of individual birds that visited and fed from the fruits of each plant. Results of the LSP metal analysis indicate bioaccumulation in fruits, birds, and invertebrates. Metal loads for invertebrate and fruit samples were higher than those of a control site. We found significant variation in metal levels among fruit species at LSP. Field observations of frugivory revealed significant differences in fruit selection among visiting bird species. Avian visitation rates were influenced by plant species, bird species, and the distance from the edge of the brownfield. These results suggest the potential for metal transfer from fruits to birds depends on a suite of factors and certain bird species may be at higher risk than others.

The influence of land management practices on the above and below ground mutualisms of the Pine Barren gentian (*Gentiana autumnalis*) in New Jersey

REBOZO, RYAN* and WALTER BIEN

Department of Biodiversity, Earth, and Environmental Sciences Laboratory of Pinelands Research, 3245 Chestnut Street Philadelphia, PA 19104
Email of corresponding author: Ryan.Rebozo@drexel.edu

The New Jersey Pine Barrens is a fire-dependent ecosystem where intense wildfires create a mosaic landscape that is in varying stages of succession. Additionally, landscape managers use mechanical mowing and low intensity prescribed burns to reduce fuel loads that lower the risk of catastrophic wildfire. Subsequently, fire suppression is a major influence on the rarity of disturbance-dependent plant species such as the Pine Barren gentian (*Gentiana autumnalis*). This fall flowering perennial thrives optimally in early successional habitats. We compared sites (treatments) that were mowed, burned (PxB), and unburned (greater than 10 years) to examine the influence of disturbance (management practices) on the demography and mycorrhizae associated with *G. autumnalis*. Because certain management practices can alter the soil chemistry (e.g., nutrient amendments), there is the potential that management practices can also alter fungal associations and ultimately the pollinator interactions of plant hosts. Thus, we compared mycorrhizae root colonization (%), pollinator visitation rates, and soil nutrient levels among treatments to elucidate differences in below and above ground interactions. A better understanding of the influence of management practices on *G. autumnalis* will be critical for the conservation of the species.

Our preliminary data suggests that the Pine Barren gentian supports a high level of arbuscular mycorrhizal colonization that increases concomitantly with an increase in density and richness of conspecifics. Insect diversity and pollinator visitation rate also increased with an increase in flowering of plant associates. Survivorship, recruitment, and fecundity for this species also vary among management practices.

Dam removal impacts on biodiversity and abundance of invasive species

GRIFFITH, ALAN B. *(1)(4), MARGARET WALKER (2) AND DAMON LOWERY (3)

- (1) Department of Biological Sciences, 1301 College Avenue, University of Mary Washington, Fredericksburg, VA 22401
- (2) Department of Biological Sciences, ELEV 9047, University of Mary Washington, Fredericksburg, VA 22401
- (3) Fish, Wildlife, and Agronomy Section, Marine Base Quantico, Quantico, VA 22134
- (4) E-mail of corresponding author: agriffit@umw.edu

Dam removal has become more common as dams age and dam owners wish to restore ecosystems to their natural state. Dam removal changes riparian areas physically, chemically, and biologically. We are interested in the biological changes after pond recession and colonization of uncovered soils. These nutrient rich soils are quickly colonized and may be dominated by invasive species. Two dams were removed in 2010 in New Kent County, Virginia on a tributary of the Pamunkey River. We wanted to know 1) how does invasive species abundance change after dam removal, 2) what is the species diversity of uncovered soils, and 3) what are relative abundances of invasive and planted species? After dam removal, species were planted in the area to help counteract the growth of invasive species. Percent cover of species and species richness was collected before and after dam removal. Data were collected transects throughout the pond area. One m² quadrats were place every 5 m on transects. Combined invasive species abundance decreased on 8 of 12 transects after dam removal. Combined invasive species abundance was 13% and planted species abundance was 40% in the lower third of the sampled watershed. Invasive and planted species covered 41% and 11%, respectively in the middle third. Species richness/ m² decreased after dam removal (8.6 to 5.2) in the lower third of the watershed, but increased in the upper third (7.5 to 10). Our data suggests good success in controlling invasive species establishment across much of this newly established riparian area.

How not to protect streams and wetlands, Pennsylvania-style

SCHMID, JAMES A.*(1)

(1) Schmid & Company, Inc., Consulting Ecologists, 1201 Cedar Grove Road, Media, PA 19063

Wetlands and headwater streams have come to be recognized as significant natural resources, easily degraded but difficult and costly to restore in the United States and worldwide. Pennsylvania claims to have the most miles of streams of any State except Alaska. Its wetlands are much less extensive than those in many States, even if less than half of those in Pennsylvania are shown by National Wetland Inventory maps. From its Constitution to its statutes to its regulations and technical guidance, and here or there in municipal ordinances, Pennsylvania public rhetoric today appears to reflect some public concern for these aquatic resources. But in the real world of development projects and regulatory approvals, stream and wetland inventory, damage avoidance, and mitigation for allegedly unavoidable disturbance are rare, driven by exceptional concern and diligence on the part of a few concerned citizens, supported by attorneys, scientists, conservation groups, and charitable foundations. Political power in the Commonwealth has long been dominated by commercial and industrial enterprises that eagerly fund elected officials now almost as brazenly as in decades past. First timber, then coal, oil, and currently shale gas extraction, along with residential and commercial development of all kinds, are damaging the environmental resources of the Commonwealth irreparably for this and future generations.

The only hope for resource preservation lies in education and in communication with the public. What is being lost? Why does it matter? What can be done? My comments emerge from four decades of experience in applying ecology.

Intersex in blacknose dace from three small wastewater-influenced streams in south-central Pennsylvania

LIGHT, THEO* (1)(3), LAUREN KESSLAK (2), and TAMMY SMITH (1)

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(3) Email of corresponding author: tsligh@ship.edu

Emerging contaminants in Pennsylvania waters include numerous pharmaceuticals, personal care products, and other common chemicals with potential endocrine activity. Recent concern about these contaminants has focused on their presence in treated wastewater and effects on wildlife, particularly fish. We examined blacknose dace (*Rhinichthys atratulus*) in three wastewater-influenced streams for gonadal abnormalities, and used stable isotope analysis to estimate dietary sewage-derived carbon and nitrogen, both to check site fidelity and as an indicator of overall effluent exposure. Fish (usually 20 per site) were collected from sites upstream and downstream of wastewater treatment plants in spring, summer and fall 2011, and again in one of these streams (Middle Spring, Shippensburg) in summer and fall 2012. Fish gonads were prepared and examined using standard histological techniques, and a portion of the tail was prepared for stable isotope analysis. We found intersex fish in all three streams in 2011 (one upstream and three downstream of effluent outflows), and both upstream (one) and downstream (five) in Middle Spring in 2012. Intersex proportion was low, ranging from 0.011 in upstream Middle Spring to 0.13 in downstream Quittapahilla Creek. All intersex fish appeared to be male on external examination of the gonads, but histology revealed from 1% to 95% female tissue. This is apparently the first record of intersex in blacknose dace. Using stable isotopes of carbon, we estimated the proportion of dace diet directly or indirectly derived from sewage was 40.5% ($\pm 5.8\%$) in downstream Quittapahilla Creek, and 22.7% ($\pm 8.8\%$) in downstream Middle Spring.

Session 1B: Mid-Atlantic Estuaries (Venetian Room)

Evaluation of tidal marsh production, functions, and values in an urban estuary

WOLLENBERG, JENNIFER* and PETER P. BRUSSOCK

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Holicong, PA 18928-0306

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Wetland production, functions and values were measured in tidal marshes as part of an ongoing remedial investigation/feasibility study (RI/FS) at an estuarine Superfund site in New Jersey. The Site is a tidal side-embayment of the Hackensack River, consisting of approximately 6.5 miles of waterways and over 1,000 acres of *Phragmites* marsh surrounded by urbanized upland. Marsh functions and values were measured using a hydrogeomorphic assessment method to quantify similarities and differences between ecosystem services provided by the marsh habitat at the Site and three local reference areas. In addition, aboveground primary production was assessed directly through measurement of biomass. Measurements were completed at multiple locations along transects extending from the waterway into the marsh, in a total of eight marshes at the Site and seven marshes in the reference areas. The wetland functions in the marshes at the Site were similar to those of the reference areas for nine of the 10 functions evaluated. Plant community composition was the only function for which an appreciable difference was noted between the Site and reference areas. This difference was heavily influenced by recent restoration initiatives in two reference areas that have modified the plant community. Above ground biomass ranged from less than 2.5 kg/m² to greater than 5 kg/m², and was higher at the Site than in reference areas. Biomass was consistently highest at locations closest to the channel at both the Site and reference areas. No relationship was observed between contaminant concentrations and biomass or wetland functions and values.

The effect of water quality goals on submersed aquatic vegetation growth and ecosystem benefits in the Chesapeake Bay

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Pollution has reduced submersed aquatic vegetation (SAV) in the Chesapeake Bay to a fraction of its historic abundance and distribution. SAV serves important ecological functions in the Bay, providing food and habitat to other species and affecting nutrient cycling, sediment stability, and shoreline erosion. The Environmental Protection Agency recently established Total Maximum Daily Load values for pollution levels that are predicted to increase SAV distribution by improving water clarity. We used the dioecious SAV species *Vallisneria americana* to determine the effect of water clarity on growth rate, expansion rate, and ecosystem benefits. Individuals from three genetic regions within the bay were grown in the target TMDL water clarity level and two levels above to measure growth, sexual and vegetative reproduction, and palatability which affect ecological function. We found that water clarity does not affect plant presence ($X^2=4.62$, $p=0.099$), but caused a significant difference in horizontal expansion (ramet production, $F=4.8$, $p=0.009$) and vertical growth (leaf length, $F=7.69$, $p=0.00061$). A light level above the TMDL target had the greatest horizontal growth. Among treatments, the source population, sex, and genotype affected horizontal growth and genotype affected vertical growth. Our results will determine the effectiveness of current pollution restrictions and help to inform the public about the importance of the TMDL.

Evaluating the potential resiliency of *Vallisneria americana* in the Potomac River (USA) using individual-based networks of genetic distances

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Large-scale losses from nutrient and sediment loading, competition with non-native species, and loss of habitat connectivity cause concern for long-term persistence of submersed aquatic vegetation and the essential ecosystem services they provide. Extensive, connected habitats are more resilient due to higher probabilities of supporting large, genetically diverse populations that can tolerate, acclimate, or adapt to environmental changes. The aquatic angiosperm *Vallisneria americana* (wild celery) has large and extensive patches of habitat throughout the Potomac River and the Chesapeake Bay, suggesting potential high resilience to perturbations. However, because the species reproduces both sexually and clonally, the extensive occupied habitat may not support the expected genetic diversity. We genotyped 757 samples from 29 sites found along tidal and non-tidal portions of the Potomac River using 10 microsatellites. We identified 415 multilocus genotypes (MLGs) and genotypic diversity within sites ranged from 0.0-1.0. The largest clone spanned over 160 river km. Genetic distances among all MLGs were used in network analysis to quantify connectivity via dispersal. Breaks in geneflow across tidal vs. non-tidal waters were observed and could be associated with changes in dispersal regime (unidirectional vs. radial) or differences in selective environmental forces. Low genotypic diversity within some sites causes concern for resilience in changing conditions.

Science synthesis: Ecohydrology and a new stormwater management paradigm

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Our understanding of aquatic and terrestrial ecological systems has evolved over the decades, and what we have learned likely has relevance in the way stormwater management controls in urban landscapes are designed and function. These include numerous small “micro-BMP” facilities that increasingly make use of vegetation (rain gardens, low impact development, green roofs, etc.). What we know about eco-hydrological processes and fluxes in urban streams and forests has great potential to advance and enhance emerging stormwater management facilities by expanding the array of tools available to their design, as well as raising the awareness of the availability of additional ecological services that could make them more efficient, multi-objective entities in the landscape.

A UDSA Forest Service R&D effort is under way at the Baltimore Field Station and UMBC to examine the available science and bridge interdisciplinary barriers in the quest for eco-hydrological science and conceptual models that might inform stormwater control design. We discuss how a four dimensional framework based on an Urban Watershed Continuum needs to be applied, both in the characterization and understanding these upland catchments and in designing stormwater management interventions. This work draws from diverse sources, e.g., civil engineering, agroforestry, stream and landscape ecology, hydrology, soil science, etc. to create a picture of what we know and establish potential cross-connections. This project is described, and an appeal made for input and participation is from the research and management communities.

Session 1C: Ecological Potpourri (Verona Room)

Population origin and genome size do not impact *Panicum virgatum* (switchgrass) responses to variable precipitation

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Responses of the genetically and phenotypically diverse C₄ grass, switchgrass (*Panicum virgatum* L.), to climate change may be driven by local adaptation to broad-scale regional climates or by intra-specific variation in genome size. However, it is unknown if intra-specific variation in genome size is more important in driving population responses to climate change than local adaptation. Therefore, we investigated *switchgrass* responses to water variability between plants collected from Kansas, Oklahoma, and Texas, USA and among individuals spanning a range of genomes sizes within these populations. Switchgrass rhizomes were planted in a mesocosm facility at the Konza Prairie LTER and small, frequent or large, infrequent watering events were applied over one growing season. Leaf-level physiology, aboveground biomass and genome size were measured for each individual. We found differences among populations in most physiological traits measured but this did not affect the response of the populations to variation in water timing, as indicated by the lack of a significant population x treatment interaction for all measured variables. Additionally, changes in physiology did not translate to changes in productivity because water variability only impacted leaf physiology after plants had nearly finished seasonal growth. We also found that, without bias of population origin, genome size did not influence the switchgrass traits measured or their responses to water variability. These results suggest that genome size may not be an important predictor of physiological differences among switchgrass individuals, and neither local adaptation nor genome size will impact switchgrass responses to altered precipitation patterns in the future.

The role of carbohydrate metabolism and sugar signaling in elevated CO₂-induced altered flowering time of *Arabidopsis thaliana*

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Transition to flowering is a critical milestone in plant lifecycles that also has ecological impacts. Plant fitness and plant-pollinator interactions depend on the occurrence of flowering and subsequent fruit production and senescence. Elevated atmospheric CO₂ has been shown to alter flowering time which may have broader ecological impacts in the future. Flowering time responses to elevated atmospheric [CO₂] have been highly variable both within and among plant species. To accurately predict flowering time responses to future increases in atmospheric CO₂ a basic mechanism is needed for altered flowering time under these conditions. Sugar and hormone signaling has been implicated as having a significant role in regulating flowering time and may therefore play a role in elevated [CO₂]-induced altered flowering time. Flowering time, leaf number, and biomass of nine *Arabidopsis thaliana* transgenic lines with a single gene mutation related to sugar metabolism and hormone signaling were compared to their respective wildtype lines when grown at current and future [CO₂]. The effects of growth at elevated [CO₂] significantly depended upon genotype in the comparison between the mutant line *abscisic acid insensitive 5-1* (*abi5-1*) and its wildtype. *Abi5-1* showed significantly delayed flowering under elevated [CO₂] whereas the wildtype line showed no significant difference between current and elevated [CO₂]. The *abi5-1* mutation is an abscisic acid (ABA) mutant that has a glucose- and ABA-insensitive phenotype. These results indicate that *ABI5* and hormone cross-talk in general could play a previously unknown role in the mechanism of altered flowering time under elevated [CO₂].

Effects of inbreeding on floral volatiles in *Mimulus guttatus*

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Mimulus guttatus is a primarily bumblebee-pollinated species with a wide range of outcrossing rates and in which inbreeding depression is often observed. In previous experiments, bumblebees discriminated against inbred *M. guttatus* independently of flower size and number. Since plant volatiles play a role in many plant-insect interactions, this suggests that bumblebees may use olfactory cues to discriminate between inbred and outbred *M. guttatus*. In this study we investigated the floral scent differences between inbred and outbred *M. guttatus*. Sixty-two compounds were emitted from all plants, so we used principal components analysis to reduce the dimensionality of this data. The first principal component (PC1) explained 40 percent of the variance in the floral volatile blend, with three compounds showing positive loadings greater than 0.3. PC1 was significantly greater for outbred than inbred plants, even with flower number and corolla width as covariates. ANOVAs of individual compounds showed significant differences in emission of six compounds, including the bumblebee pheromone β -farnesene. β -farnesene was emitted in the second-highest amount on average, and was present in 25 of 26 outbred plants, but only in 5 of 10 inbred plants. Thus, β -farnesene played a large role in the scent difference between inbred and outbred plants and is a strong candidate for explaining the bumblebee discrimination against inbred plants. We plan to investigate bumblebee visits to artificial flowers with manipulated scents to determine the role of β -farnesene in bumblebee behavior. These results will provide insight on inbreeding depression of volatile phenotype and its implications in mating-system evolution.

The effect of invasive species on soil characteristics and microbial communities at Powdermill Nature Reserve

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We investigated the effect of invasive species on soil chemistry, physical structure, and microbial communities in eight forest plots at Powdermill Nature Reserve in Rector, PA. Four interior and four exterior plots were compared and evaluated for the presence of invasive species. Soils from each plot were analyzed for physical and chemical characteristics. Interior and exterior plots differed significantly for the aggregate soil traits of pH, soil moisture, bulk density, and organic matter content (MANOVA Hotelling's Trace = 2840.2, $F = 710.0$, $p < 0.001$). Invasive woody plants were found exclusively in exterior plots. Consequently, for the four exterior plots, microbial metabolic diversity from A and B horizons of native plant rhizospheres are being compared with those from exotic plant rhizospheres using Community-Level Physiological Profiling (CLPP). (Metabolic analyses are ongoing, but will be presented at meeting.)

Pea aphid, *Acyrtosiphon pisum*, symbiont diversity over time and space

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Aphids, whose populations in nature are regulated by natural enemies and abiotic conditions, are known to feed on a variety of plant species. Because of their diversity, they can reach high densities on crops such as alfalfa and clover. The pea aphid can harbor one or more of seven known heritable secondary symbionts that can provide ecological benefits such as thermotolerance, defense against parasitoid wasps and fungal pathogens, and host plant utilization. Variable environmental conditions may influence symbiont presence which can impact genetic diversity. This could explain the high variety of secondary symbionts in the pea aphid. To better understand the relationship between biotic and abiotic seasonal changes and the prevalence and diversity of these symbionts, aphids were collected from alfalfa and clover in New York and Pennsylvania over nine sampling dates. Using PCR, the infection status of over 900 pea aphid samples was determined by testing for six known secondary symbionts. It was expected that symbiont frequencies would differ in correlation to changing environmental conditions. An average of 1.7 to 2.3 symbionts per aphid was discovered on clover and alfalfa, respectively. Observed co-infection frequencies, combinations of certain symbionts per aphid, occurred more often than expected. Also, high multiple infections were observed on several dates in alfalfa. These data suggest that multiple infection status varied over time and space and may provide benefits to pea aphids under certain environmental conditions. Few studies have analyzed the fitness costs or benefits of multiple infection, suggesting a clear need for further investigation.

Session 2A: Terrestrial Fauna (Siena Room)

Radio telemetry on the neonate ecology of the northern pine snake (*Pituophis melanoleucus*)

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Due to the cryptic and fossorial nature of Northern pinesnakes (*Pituophis melanoleucus*), there is a lack of data on their early life behavior and dispersal. An understanding of first season life history traits from hatching to ingress is particularly difficult to monitor. Without field observations, it is difficult to elucidate key developmental processes, such as shedding rate, feeding rate, diet preference, habitat preference, dispersal patterns, and the spatial ecology after leaving the nest. These life history factors could have pronounced effects on land management concerning this species, State Threatened in New Jersey. Until recently, the use of radio telemetry was only applicable for adult pinesnakes. External transmitters are not appropriate for semi-fossorial constrictors as they interfere with normal snake behaviors such as prey handling and excavation. However, we surgically implanted eight *P. melanoleucus* with small transmitters, less than 3% body weight, and radio-tracked them after leaving their nests to fall ingress. We monitored neonate activity daily and recorded environmental and behavioral data. Neonates preyed on small adult rodents and shed multiple times over the first season. Radio telemetry helped confirm black racers (*Coluber constrictor*) as a predator of neonate pinesnakes. Neonates traveled distances from the nest ranging from 30m to 300m. Neonates with pit-tags only were observed within 70m of the nest throughout the field season. Our data suggest that the use of radio-implanted transmitters in neonate pinesnakes does not negatively impact normal snake activity, behavior, and movement patterns and may be applicable to other cryptic species.

The impact of caudal autotomy on growth in *Sceloporus jarrovi* (Phrynosomatidae)

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Despite known autotomy affects on lizard reproduction, locomotion and survival, few studies have examined the degree naturally occurring autotomy or subsequent effects on growth. We examined both in a population of Yarrow's spiny lizard (*Sceloporus jarrovi*) and found that approximately 30% of individuals in the population showed evidence of autotomy with a typical degree of tail loss between 17-37% (median=27%). However, if survivorship is affected by the amount of loss, animals with more extensive loss may be underrepresented in the population and the actual average tail loss greater. We estimated affects on growth by comparing the SVL, total length (TL), non-regrown tail length (NTL), and regrown tail length (RTL) of animals with intact tails to animals exhibiting autotomy. We found that growth rate for SVL to be unaffected by autotomy ($p=0.085$; $t=1.40$; $d.f.=40$), but TL to be greater for intact animals ($p=0.038$; $t=1.82$; $d.f.=32$) and NTL to be significantly greater ($p=0.009$; $t=2.81$; $d.f.=27$) for intact ($24.3\pm 19.0\text{mm}$) than for autotomized lizards ($5.0\pm 4.0\text{ mm}$). Individuals which have previously regenerated some tail had a higher rate of RTL growth ($5 \pm 6.1\text{mm}$) than those experiencing autotomy for the first time ($1 \pm 4.1\text{mm}$; $p<0.001$, $X^2=14.05$, $d.f.=1$). Because the severity of natural tail loss appears to be considerably less than the usual degree of autotomy experimentally applied, we suggest that studies examining the influence of tail loss may need to be adjusted.

The effects of substrate type on the behavior and movement of *Pituophis melanoleucus*, the northern pine snake

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Paved and unpaved roads can act as barriers to ecosystem connectivity linkages. Increased road density contributes to habitat fragmentation, wildlife mortality, loss of genetic corridors, and decreased reproductive success. Roads represent a major threat to slow moving herpetofauna that are extremely vulnerable to vehicular road injuries and death. Of 536 reported occurrences for northern pine snakes (*Pituophis melanoleucus*) in the New Jersey biotics database 120, or 23%, were dead on road (NJDEP, 2009). We examined the mean rate of movement of the northern pine snake across three different substrates: sand, asphalt, and concrete. We tested twelve snakes (n=12) in spring, summer, and fall 2012 at the Warren Grove Gunnery Range (WGR), Burlington County New Jersey. Snakes had the fastest rate of movement across sand (\bar{x} =0.11m/s) compared to paved substrates: asphalt (0.09m/s) and concrete (0.06m/s). These data suggest that coarser substrates facilitate increased mobility of snakes. In addition, we examined whether snakes would move through under-road-culverts. We installed nine 12-inch diameter culverts under a new military runway at WGR to monitor wildlife movements. We documented 364 'visits' at the mouth of the culverts and 54 'usage' events (14.8% culvert usage by visiting fauna, including snakes). These data support that culverts are a viable option for mitigating road impacts to wildlife. To better understand the impact of roads on genetic exchange of pine snakes a landscape genetic study is warranted.

Using DNA and microhistological analysis to examine competition of two sympatric cervids

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Sika deer (*Cervus nippon*) were introduced to Maryland in 1916 and may be excluding native white-tailed deer (*Odocoileus virginianus*) from dietary resources. In order to determine dietary resource overlap between these species, we collected fecal samples from areas with an equal mix of both species. Restricted fragment length polymorphisms of mitochondrial DNA (from sloughed epithelial cells on fecal samples) were identified to species on agarose gels, eliminating the need for DNA sequencing. Results from restrictions were confirmed with tissue samples from the harvested individuals. Fecal pellets were grouped according to season and species for microhistological analysis.

Sika deer consumed a wider variety of plants (25 species compared to 18 for white-tailed deer) and 13 species showed overlap between both ungulates. Although white-tailed deer diet was comprised of a larger percentage of woody vegetation (79% compared to 38%), there was a high degree of plant species overlap (8 of 10 species). A single woody plant constituted at least 29% of both diets. Sika deer consumed more grasses (43 % compared to 16%) and showed use of resources that white-tailed deer did not exploit: 5 grasses and 3 forbs comprising 34% of total sika deer diet. Sika deer also took advantage of more sedges, rushes, ferns, and nuts than white-tailed deer. In areas where diet overlap exists, sika deer may be excluding white-tailed deer from resources. In addition sika deer are able to exploit habitat that is not suitable for white-tailed deer. Our aim is to provide information for the proper management of the native species which may include reduction of sika deer numbers and range expansion.

Session 2B: Mid-Atlantic Estuaries (Venetian Room)

Using geographic information system technology to spatially analyze the environmental conditions affecting nesting site selection of the *Malaclemys terrapin*

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The Diamondback Terrapin, an estuarine species, has one of the greatest geographic distributions for a single species of turtle; yet, populations of this species are declining. These animals are classified as a species of concern by the Endangered Species Act and each state has their own classification of the status of the Diamondback Terrapin. Terrapins are being exposed to habitat destruction from developments in coastal zones, decreased nesting territory due to habitat fragmentation, increased predation upon nests, and drowning in commercial crab traps. A major emerging problem that may add additional threat to the population of this species is flooding. Rising sea levels make flooding more prominent and is an increasingly serious problem for the terrapin population. A population of Diamondback Terrapins was observed during the nesting season of 2012 at a known nesting location on a constructed trail at the Wetlands Institute located in Stone Harbor, NJ. Nesting locations were georeferenced using Global Positioning System (GPS) technology. Ground water monitoring wells were installed along the trail in close proximity to terrapin nesting sites and water elevations were collected during storm events and tidal cycles. This data was compared to elevation data to determine flooding within nest cavities. Nesting trends along the trail were also spatially analyzed using a Geographic Information Systems (GIS) to determine if terrapins chose nesting sites which were at a higher elevation and therefore away from flooding. The results of this study could allow for better conservation methods for this species of terrapin.

Competition between red-bellied turtles (*Pseudemys rubriventris*) and invasive red-eared slider turtles (*Trachemys scripta elegans*)

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

Chesapeake Bay nutria eradication program overview

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Nutria, (*Myocaster coypus*) a semi aquatic rodent native to South America, were introduced to Maryland's Eastern Shore near Blackwater National Wildlife Refuge (NWR) in 1943. By the 1970s, coastal wetlands on the Chesapeake Bay were deteriorating rapidly while nutria populations were expanding dramatically. In the mid-1990s, experiments conclusively linked marsh loss nutria herbivory, leading to the decision to eradicate nutria from the Delmarva Peninsula. A Partnership of Federal, state and private organizations was convened and funding to investigate the feasibility of eradication was provided by the Nutria Control and Eradication Act of 2003. Following a brief investigation into the life history and local ecology of nutria in the Chesapeake Bay ecosystem, the partnership launched an operational plan to systematically eradicate nutria from Blackwater NWR and surrounding state and private lands in 2002. By 2006 nutria had been virtually eliminated from southern Dorchester County and the program was expanded. Since then, nutria have been removed from 160,000 acres from several watersheds in five counties in Maryland's lower eastern shore facilitating the recovery of some damaged marshes. Nutria have since been detected in Delaware and Virginia and current efforts to delimit the extent of the population are underway. Once distribution is clearly defined, a systematic plan to remove remaining populations will be initiated.

Effects of water quality on catch per unit effort of juvenile lemon sharks, *Negaprion brevirostris* poey, in the coastal waters of South Caicos, Turks and Caicos Islands, British West Indies

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In recent decades sharks have become increasingly threatened due to overfishing, within shark fisheries and through bi-catch, and human development, thus, lemon sharks (*Negaprion brevirostris*) have recently been placed under the protection of NOAA's Secretarial Fisheries Management Plan and the IUCN near-threatened listing. A study was conducted in South Caicos, Turks and Caicos, British West Indies, on the effects of water quality on the catch per unit effort (CPUE) of juvenile lemon sharks. Over the course of 25 days, 47 elasmobranches were captured using a monofilament gillnet and tagged with T-bar anchor and plastic headed or metal headed dart tags. Dissolved oxygen, salinity and temperature readings were recorded every hour at the beginning and end of the gillnet, as well as at shark capture sites. I found no significant difference between water qualities from the beginning to the end of the net. Dissolved oxygen levels did produce a significant relationship with site CPUE, as well as an overall significant difference between CPUEs calculated for the different locations. The proceeding temperature and salinity, however, were not significantly related to the CPUE of a site. Due to limited time and small sample sizes, further study analysis is suggested to determine definitive relationships between abiotic factors and juvenile lemon sharks.

Session 2C: Public Outreach & Science Education (Verona Room)

Birdies, eagles, and...bats? Unexpected public outreach opportunities for bat conservation on golf courses

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Public outreach is an important component of science, specifically for wildlife conservation. The need for scientists to reach out to the public to transfer knowledge and excitement for conservation is imperative to implement important conservation milestones, such as protective legislation. Seeking out new ways to reach the public can broaden scientists' impacts. Conventional outreach methods include pre-organized activities with K-12 classes, community lectures, field trips, etc. However, we suggest that it is necessary to be an advocate for science anytime researchers are in the public eye. While conducting field work for my Master's thesis focused on bat activity on golf courses, we were able to interact with and educate an unexpected demographic: golfers and those living in golf communities. Golf courses have often been under scrutiny for management practices that are detrimental to the environment. Studies have also shown golf courses' potential to serve as wildlife refuges for certain species. While a golfer's primary reason for being on a course is to golf, in my experience most people I encountered were genuinely interested in the work I was doing, often leaving the conversation with new information about bats-an often misunderstood animal. Here we present generalized guidelines for public outreach meant to assist scientists in encounters with the public during fieldwork.

Synthesizing to teach ecology: Using ethnographic, socioeconomic, and environmental science data to teach undergraduates the actionable science and ethical responses to the challenges imposed upon arctic nations by climate change

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Global climate change will test the resiliency of our civilization this century. We must synthesize multidisciplinary knowledge, skills, and ways of knowing to meet unprecedented ecological challenges, and we need to improve our students' understanding and engagement in these issues. Climate change is presently occurring rapidly in the Arctic, and the Inuit peoples who live there are now experiencing climate change induced social upheaval. We have much to learn from their adaptive struggle and about our own capacity for adaptive response. This rich context forms the content of a multi-week student-centered multidisciplinary jigsaw-based teaching activity I will describe in this talk. Data on student learning from this activity span five semesters of development, deployment, and revision in Widener undergraduate courses (majors to non-majors). In this activity, students select an Inuit community out of the circum-polar international Inuit distribution and research place-based (1) environmental and ecological data, (2) Inuit ethnographic data and traditional ecological knowledge, and (3) Inuit social science data on food security, health, housing, education, economic development, and other measures of social infrastructure. According to student pre-post tests and reflective self-assessments, learning gains occurred in students' (a) understanding of the science of climate change and anthropogenic causality, (b) understanding place-based and culturally relevant Inuit environmental knowledge, (c) capacity to analyze, integrate, communicate, visualize, and synthesize interdisciplinary knowledge from scientific, ethnographic, and social science sources, and (d) capacity to use utilitarian and deontological ethical arguments to evaluate claims regarding actions to take to improve Inuit cultural survival and resiliency.

Innovative ecological education instructional strategy in an online environment

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Promoting ecology in an online setting has gained increased popularity over the years. However, studying ecology at a local level in an online setting can potentially have its challenges as students may be physically located anywhere across the world with extreme differences in geography, season, and/or access. This presentation will describe one of the innovative assignments designed in an Ecological Interactions class where students create their own “Virtual Garden” over the course of a 10-week period. This project requires students to conduct research and prepare a literature review specific to their geographical area, starting with plants found in their local area (both native and non-native). As students progress through the term, they learn about various concepts such as competition, food webs, predation, parasitism, and disturbance, among others. Ongoing discussion of these concepts are facilitated during weekly discussion boards, and live online synchronous seminars where students are able to ask questions of both their peers and the instructor in real-time. With each passing week, students continue to build the complexity of the natural environment in their Virtual Garden and implement said concepts until they have realized a ‘healthy’ Virtual Garden with maximum yield.

Poster Presentation Abstracts

The impact of Japanese knotweed on stream water content of the Peckman and Third Rivers, NJ.

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With New Jersey's ever growing population, it is imperative to preserve as much fresh water as possible in its watersheds. In the last decade New Jersey has experienced several droughts and we are interested in finding ways to reduce fresh water resource depletion. Data collected in previous years showed that there may be a significant correlation between the prevalence of an invasive plant species, Japanese knotweed, and water loss in streams belonging to the Passaic River watershed. To assess the impact of Japanese knotweed on stream water loss, we estimated total knotweed distribution along the Peckman and Third Rivers, tributaries of the Passaic River, using a combination of field measurements and GIS during the summer of 2012. These data were used to calculate the amount of ground area occupied by knotweed per river. At three stands along these rivers, physiological measurements were taken from randomly selected plants from sunrise to sunset once every hour to observe transpiration rates per unit leaf area. In order to scale these transpiration rates to the stand level, we determined total leaf area for each stand and multiplied this by transpiration rate. To determine total water loss per stand on a ground area basis we divided total stand water loss by total stand area. Total water loss per ground area was multiplied by the total ground area occupied by knotweed along each river to give us an estimate of total water loss per river due to knotweed presence. These results were compared to total annual river flow and summer base flow. The results suggest that knotweed along these rivers may reduce total flow by about 2%, but by as much as 10% during the summer months.

Chronic water stress alters growth and physiology of American beachgrass, *Ammophila breviligulata*

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American Beachgrass, *Ammophila breviligulata*, is a pioneer plant critical in stabilization and expansion of coastal dunes. Restoration projects replant dunes with a single genotype of American Beachgrass, 'Cape', with mixed success. Native NJ genotypes were collected for comparison to 'Cape' in response to water stress. We examined physiological effects and height growth differences among the five strains and across three watering treatments in the greenhouse. Photosynthetic rates were not affected by water stress, but strains were only marginally different. Stomatal conductances, however, were lower for the lowest water availability and exhibited differences across strains, with 'Cape' having the lowest conductance. Height growth rates did not differ among water treatments, but did differ across strains, with 'Cape' having the lowest height growth rates. If populations are genetically diverse, so is the performance. These findings may translate to restoration projects reliant on 'Cape' monocultures being less favorable compared to genetically diverse populations. In addition, other factors such as disease or changing environmental conditions could wipe out monoculture more easily than a genetically diverse population.

Water stress alters growth and biomass allocation of five strains of American beachgrass, *Ammophila breviligulata*

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Ammophila breviligulata, American beach grass is a primary colonizer of sand dunes on north eastern coastal barrier islands. Robust dunes offer storm surge protection and property loss mitigation. Dune loss can occur during these events, which is often followed by accelerated restoration by planting a single strain of beach grass referred to as ‘Cape.’ Restoration with ‘Cape’ can result in mixed success with some populations showing 100% mortality. We hypothesize water stress as being the common stressor limiting establishment. Therefore, we examined how ‘Cape’ and native NJ strains of beach grass respond to different water availabilities. NJ strains of beach grass were collected from Sandy Hook (SH), Island Beach (IB), Little Beach (LB) and Cape May (CM) and propagated in the WPUNJ greenhouse facility. Thirty clones of each strain including ‘Cape’ were subjected to three watering treatments, daily saturation, 1/2 saturation and 1/4 saturation. Water Potentials and height measurements were taken weekly. After 3 months, plants were harvested and separated into above and below ground biomass. Water potential effects were similar across strains, but were lowest for the low water treatment. Strain and water treatment differences existed in root:shoots ratios and total biomass with native strains NB and LB showing significantly greater root:shoot ratios. The LB strain had the greatest mean biomass when compared to any other strain. Specific leaf area and specific root area showed no response to water stress but showed significance differences among strains. Our results suggest genetically distinct grasses may differ in their ability grow and allocate biomass under water stress. Genetic monocultures of ‘Cape’ used in restoration efforts may contribute to planting failure. Taken together other environmental stressors among genetically diverse beach grass strains may give the population the ability to survive variable conditions thus increasing restoration success and long-term dune stability.

Effects of methoprene and larvae on invasive mosquito reproduction

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Introduced species are those non-native to a region whose establishment can cause ecological or economic harm. For example, Asian tiger mosquitoes (*Aedes albopictus*) represent a major health risk to both humans and wildlife by transmitting numerous viral diseases. Methoprene is a common method of larval mosquito control that kills larvae by preventing metamorphosis into adults. Such control programs assume that females lack the ability to detect this pesticide at breeding sites and thus freely lay their eggs in treated areas. If true, females still might avoid sites only after methoprene begins to kill larvae. In two experiments, we tested how *introduced* (*A. albopictus*) female mosquitoes responded to the presence of methoprene and mosquito larvae *at experimental breeding sites*. Females laid significantly fewer eggs in areas containing both methoprene and *Culex restuans* larvae (methoprene x larvae interaction, $p = 0.03$) but showed no avoidance of areas with the pesticide and *A. albopictus* larvae. These data suggest that common control methods might not be as effective under certain conditions when they induce avoidance behavior in female mosquitoes.

A stable isotopic and fatty acid foodweb comparison of Atlantic and Gulf menhaden

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Atlantic menhaden (*Brevoortia tyrannus*) and Gulf menhaden (*Brevoortia patronus*) are keystone forage species that can be found along the eastern coast of the US to the Gulf of Mexico. This important species serves as a food source for recreational and commercial fish such as striped bass. Menhaden feed on phytoplankton and zooplankton, giving them a unique lipid content. This study compares the isotopic signatures and fatty acid composition of plankton and fish found in the Gulf and Atlantic. The goal is to determine the effect climate change has had on the lipid quality and quantity of menhaden found in the tropical region of their range versus the temperate region. Samples of fish, diatoms, copepods, and water were collected during spring and summer from the Chesapeake Bay, Md and Apalachicola Bay, Fl. Tests included $\delta^{13}\text{C}$ stable isotopic analysis, $\delta^{15}\text{N}$ of water sample NO_3^- and fatty acid content. Lipid analysis was conducted using a gas chromatography/ mass spectrometer while stable isotopic composition was determined using an isotope ratio mass spectrometer. Differences between stable isotopic signatures were found when comparing Gulf and Atlantic menhaden and their diet species. The overall aim is to provide a health status of this species.

Investigating the impact of *Phragmites australis* on essential Blue Crab habitat in Blackbird Creek, Delaware.

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The Blue Crab (*Callinectes sapidus*) is a very distinctive and commercially important species found throughout the Delaware and Chesapeake bays. While *C. sapidus* is generally perceived as being a foraging bottom dweller, the blue crab also utilizes various intertidal marsh habitats. Blue crabs flourish in the dynamically structured mosaic of subtidal and intertidal marsh vegetation where the leaves, roots, and stems of plants provide sources of food and shelter. Blackbird Creek has been subject to a loss of plant and animal biodiversity over the past several decades due largely to the increasing prevalence of the common reed (*Phragmites australis*). This study aims to evaluate whether or not an increase in the relative abundance of *P. australis* has a deleterious effect on available blue crab habitat. Sites for blue crab sampling have been selected based on 3 treatments: *Spartina alterniflora* dominated, *P. australis* dominated, and intermediate *Phragmites* invasion. An otter trawl and crab traps are being utilized in the sampling at all locations on a weekly basis from May through November and the sex, carapace width (mm), maturity stage, and molt stage of each individual is recorded. Average CW from *Spartina*, *Phragmites*, and intermediate *Phragmites* invasion sites are 75, 106 and 113 cm, respectively. The total number of crabs caught at *Spartina*, *Phragmites*, and mixed sites are 173, 105, and 41 individuals respectively. 43%, 55%, and 39% of the crabs from *Spartina*, *Phragmites*, and intermediate *Phragmites* invasion sites were female.

Spring distribution and abundance of salamanders (Order Caudata) in the mid-Atlantic region of the United States.

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Every spring since 2005, my graduate Field Biology class has traveled across 4 states (MD, PA, VA WV) in search of diverse ecosystems and the organisms they hold. One taxa which we have been particularly successful in locating is salamanders (Order Caudata). During our fieldtrips, taken between 1 Mar and 30 April each year, systematic searches for salamanders were conducted in both terrestrial and aquatic habitats. Overall, we have found 14 species of salamanders, with the most common terrestrial species being the red-backed salamander (*Plethodon cinereus*). The most common aquatic species has been the mountain dusky salamander (*Desmognathus ochrophaeus*). In this paper, I present the salamander fauna found at each of our 7 fieldtrip sites in 4 states over the 9-year period, along with some observations on salamander diversity for the region. Several species of salamanders within this range have eluded us; however, we either do not have any, or do not have sufficient, habitat for these salamanders at our fieldtrip sites. Although relatively small in body size, salamanders can make up a substantial portion of the biomass of an ecosystem, and play important roles in ecosystem functioning. Further, they tend to be particularly sensitive to environmental quality and thus serve as reliable biomonitors. Thus, long-term monitoring efforts such as this are important in documenting how salamanders are dealing with environmental change.

Macroinvertebrate and chemical assessment of the water quality in Middle Spring Creek, Shippensburg, PA.

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Middle Spring Creek, located in Franklin and Cumberland Counties in south-central Pennsylvania, flows through agricultural and urban areas, and has an underlying limestone geology. The need for water quality monitoring has increased since the creation of a watershed implementation plan for Middle Spring Creek in compliance with the 2010 Chesapeake Bay Total Maximum Daily Load, intended to decrease the amount of nitrogen, phosphorus, and sediment entering the Chesapeake Bay. Macroinvertebrate assemblages are often used to determine water quality, but invertebrate communities differ dramatically between limestone-influenced and freestone streams, requiring the use of specialized biotic indices. A result that is normal in a limestone environment may indicate poor water quality using a biotic index designed for freestone streams. We collected macroinvertebrates and measured temperature, pH, conductivity, dissolved oxygen, turbidity, alkalinity, nitrate, and phosphate levels at eleven sites in the fall of 2012. The water quality of each site will be determined using the ALLARM protocol (for volunteer monitoring), an index for freestone riffle-run streams, and an index for limestone streams. Nitrate levels ranged between 2.0-4.6 mg/l NO_3^- , with the higher levels at the site below the wastewater treatment plant and in Shippensburg. Higher phosphate levels were found in the agricultural areas, 0.13-0.22 mg/l PO_4^{3-} , than the urban areas, where most sites were between 0.04-0.08 mg/l. Turbidity varied greatly within each of the two land uses and ranged between 1.81-7.89 NTU. Alkalinity at nine of the eleven sites was over 140 mg/l CaCO_3 , indicating a limestone influence within the creek.

Response of salamanders to legacy sediment removal at Big Spring Run, Lancaster, Pennsylvania.

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Streams in the Piedmont physiographic province of the Mid-Atlantic United States are strongly impacted by legacy sediments deposited as a consequence of European settlement. In a novel wetland restoration effort, legacy sediments were removed from Big Spring Run (BSR), Lancaster County, PA in autumn of 2011. Our study focuses on the impact of the restoration on salamander populations. We surveyed three stream branches (Main, East and West) of BSR in July of 2010 and May/June of 2011 and 2012. Kennel Run, an upstream segment of BSR, was also surveyed in 2011 and 2012. The restoration occurred in the Main and West branches. East branch and Kennel Run served as controls. We captured salamanders using dip nets, litterbags, and kick nets. *Eurycea bislineata* (northern two-lined salamander) was the most common species caught. Litter bags and dip nets yielded the highest detection probabilities for *E. bislineata*. Captures of this species decreased in the restored branches, increased in East branch, and was relatively constant in Kennel Run between May 2011 and May 2012. The total population size of *E. bislineata* decreased in the six months following the restoration. In contrast, *Pseudotriton ruber* (red salamander) was more common after the restoration, having been caught for the first time in the Main branch. These species-specific responses were not surprising given the massive alteration to the ecosystem. We will continue monitoring to determine the long-term impact of legacy sediment removal on salamanders.

The effect of temperature change on the behavior of the northern pine snake and implications for climate change.

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Although studies have examined the spatial ecology, habitat use, and long-term hibernacula use of *Pituophis melanoleucus* (Northern pine snake) in the New Jersey Pine Barrens, few studies have focused on the influence of seasonal temperature variation on snake behavior. Because snakes are poikilotherms the temperature of their surroundings influences their behavior, ecology, and physiology. The New Jersey population is at the limit of its northern range where spring temperatures are variable and in recent years mean spring temperature has arrived earlier. These changes may cue earlier egress from overwintering dens. We measured the soil surface and air temperature (1m above ground) at three hibernacula to determine the temperature at which snakes egressed from dens. We also measured the operative temperature (soil/air) of radio-tracked snakes from April - November in 2010 (N=21), 2011 (N=32), and 2012 (N=21) and calculated the mean linear distance traveled per day (m/day).

Snakes egressed starting 7 April (2010), 10 April (2011), and 23 March (2012) when temperatures ranged between 24 and 33°C. In March 2012 two snakes were found dead within one meter of hibernacula; mortality was attributable to an unusual early warming period followed by night temperatures falling below freezing. Snakes were most surface active when temperatures ranged from 20 to 35°C (air) and 25 to 30°C (soil). Mean linear distance traveled per day was greatest in June (\bar{x} =113m; +/-25m) and July (\bar{x} =105m; +/-31m). Although more long-term data is needed, these data suggest that shifts in temperature regimes have the potential to alter egress and dispersal.

Impact of historical milldams on habitat of the bog turtle (*Glyptemys muhlenbergii*), a federally listed species.

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The bog turtle, *Glyptemys muhlenbergii*, is a federally listed threatened species under the United States Endangered Species Act that currently only inhabits isolated pockets within its historic range. This species occupies shallow, freshwater wetlands and wet meadows dominated by tussock sedges. Like many other species, the bog turtle is impacted by habitat loss and degradation. We argue the major driver of this habitat loss is wetland burial that resulted from the construction and later removal of milldams during the 17th to 19th centuries. We report on the virtually identical overlap of historical bog turtle habitat and historical milldam presence across the Mid-Atlantic United States. We georeferenced 280 historical locations of known bog turtle habitat and compared these locations to those of known milldams. Milldams were of particularly high concentration in the Mid-Atlantic region of the nation, the same region with the greatest concentration of previously documented bog turtle populations. This overlap supports our hypothesis that bog turtle habitat is buried under 18th-19th century millpond sediment. Conservation efforts for the bog turtle are more likely to succeed if they incorporate loss of bog turtle habitat due to the burial of valley-bottoms that this species once inhabited. Our findings suggest new opportunities to restore bog turtle habitat and recover bog turtle populations.

Perceptual landscape of suburban deer.

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Studies of animal movements have traditionally focused on time allocation of the individual animals in various habitats. In this study, the movement of 34 deer instrumented with GPS/GSM radio-collars that transmit spatial and temporal data at high-frequency intervals (5 min) were monitored and analyzed within a natural area preserve and surrounding lands in the Philadelphia suburbs. Brownian bridge trajectories were constructed between the location fixes and overlain on a vegetation map of the sample study area. The resulting map of the ‘deer perceptual landscape’ is then modeled based on habitat characteristics. The model was extrapolated to the entire study area and compared to the density of movements of the tracked deer. The resulting map of the ‘perceptual landscape’ of the deer indicates locations of high deer frequency and partial probabilities of deer visits to various landscape features and habitats. The perceptual landscape appears to be predetermined by the geography of human movements and human-made structures as well as locations of overgrown patches and neglected areas.

Does wind affect habitat choice of white-tailed deer?

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A total of 28 white-tailed deer were monitored using high density radio-tracking (5 min between fixes) in a suburban land area north of Philadelphia that includes the Pennypack Ecological Restoration Trust (PERT) preserve. GPS location fixes of deer were merged with weather parameters from a nearby weather station. The slope, aspect, elevation and habitat type of the deer GPS fixes were analyzed with respect to wind speed and wind direction. Wind directions at the time that fixes were taken were compared between fixes located north and south of the median latitude, and east and west from median longitude. All tracked individuals were highly selective for slope at the various wind speed gradations analyzed. Both aspect and elevation appeared to show no selectivity by the deer when analyzing for wind speeds only. The animals were more randomly distributed along aspect gradients at higher wind speeds. Circular regression analysis of wind direction versus aspect of patch selected by deer reveals that the deer routinely select patches with aspect either leeward or tangential to wind direction. Effects of the wind direction on the usage of different directional portions of home ranges are discussed.

A spatially and temporally concurrent comparison of popular deer abundance estimators.

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Obtaining accurate estimates of population demographics is essential to the formation of a sound deer management strategy. Several methods for obtaining population estimates exist, however each method is vulnerable to its own unique biases. Without knowledge of true population demographics, these biases are difficult to detect. The use of multiple estimators, however, allows for a comparison of both point estimates and measures of precision that may expose the limitations of a given method. We obtained demographic estimates using 3 survey methods; motion triggered camera survey and line-transect distance sampling via both spotlight and FLIR surveys. We are currently analyzing a fourth estimator using extracted fecal DNA for a mark recapture study. In order to avoid seasonal behavioral differences and regional variation, we performed all survey methods over a concurrent spatial and temporal scale in Maryland's Green Ridge State Forest. We drove spotlight and FLIR transects on alternating nights and obtained density estimates using software DISTANCE. We arranged cameras in a 247 acre systematic grid and followed Jacobson's individual branch antler method to analyze photographs. Spotlight and FLIR surveys generated similar point estimates, however FLIR produced a tighter confidence interval (11.11-24.58 deer/mi²) and lower coefficient of variation (17.4%) than did spotlight surveys (9.14-26.44 deer/mi² and 26.1%, respectively). The camera survey did not provide measures of precision and resulted in a point estimate (31.82 deer/mi²) nearly twice as great as distance sampling and outside the confidence intervals of both methods. We suggest caution when implementing management strategies based on the methods presented, as the discrepancy between distance sampling and camera survey estimates are appreciable.

Hi-resolution mapping reveals interactive spatial distribution of multiflora rose, other shrubs and white-tailed deer in the Delaware River Estuary watershed.

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A detailed map of vegetation in a mostly wooded patch of the Pennypack Ecological Restoration Trust (PERT) preserve north of Philadelphia, PA was accomplished using a grid scheme (permanent grid locations and sampling 20 feet apart). The patch is a mixture of woods, some lawns, small fields mown once a year, shrubs along footpaths and some shrubby areas that have been mown once every few years. The results of a separate radio-tracking study on the location and movement of 23 individual deer in the same study area were overlain on the vegetation map. The vegetation parameters (including shrub density and height, as well as ground cover) have statistically significant power to predict spatial patterns of deer density. The spatial relationship between Multiflora rose and deer density indicates that the deer frequent patches where the plant is present. However, in the areas of highest deer density there is little to no Multiflora rose present. These results suggest that the deer either eradicate the shrub in their bedding areas or that Multiflora rose cannot grow in the habitat where deer prefer to bed. Spatial relationships between vegetation parameters and deer density are discussed.

How not to protect streams and wetlands, Pennsylvania-style.

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Wetlands and headwater streams have come to be recognized as significant natural resources, easily degraded but difficult and costly to restore in the United States and worldwide. Pennsylvania claims to have the most miles of streams of any State except Alaska. Its wetlands are much less extensive than those in many States, even if less than half of those in Pennsylvania are shown by National Wetland Inventory maps. From its Constitution to its statutes to its regulations and technical guidance, and here or there in municipal ordinances, Pennsylvania public rhetoric today appears to reflect some public concern for these aquatic resources. But in the real world of development projects and regulatory approvals, stream and wetland inventory, damage avoidance, and mitigation for allegedly unavoidable disturbance are rare, driven by exceptional concern and diligence on the part of a few concerned citizens, supported by attorneys, scientists, conservation groups, and charitable foundations. Political power in the Commonwealth has long been dominated by commercial and industrial enterprises that eagerly fund elected officials now almost as brazenly as in decades past. First timber, then coal, oil, and currently shale gas extraction, along with residential and commercial development of all kinds, are damaging the environmental resources of the Commonwealth irreparably for this and future generations.

The only hope for resource preservation lies in education and in communication with the public. What is being lost? Why does it matter? What can be done? My comments emerge from four decades of experience in applying ecology.

Herbivory response of *Murgantia histrionica* to a Ni-hyperaccumulator, *Alyssum murale*.

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Alyssum murale (Brassicaceae) is a nickel-hyperaccumulator native to the Mediterranean region that is generally found on serpentine soils derived from ultramafic rock. Martens and Boyd (1994) proposed the “elemental defense hypothesis,” suggesting heavy metal hyperaccumulation is advantageous in reducing herbivory by insects on plant tissue. *Alyssum murale* also produces glucosinolates as a chemical defense, in addition to the physical defense of trichomes present on leaves, stems, flowers, and fruits. *Murgantia histrionica* (harlequin bug) is an aposematic stink bug that primarily feeds on plants in the *Brassicaceae* (mustard) family. This study explored two questions: Does variation in shoot Ni levels prevent or deter herbivory by *Murgantia histrionica* on *Alyssum murale*? and Does *Murgantia histrionica* show preference for stem vs leaf feeding on *A. murale*? *A. murale* plants were grown in four soil Ni treatments (0 ppm, 100 ppm, 500 ppm, and 2000 ppm). Field-captured *M. histrionica* individuals were starved for 24 hours before feeding trials. Each trial consisted of releasing one insect into a cardboard feeding arena containing four plants (one from each soil Ni level). We found no significant difference in time spent (feeding or not feeding) on all treatments, suggesting that *Murgantia* is not deterred by *A. murale* with higher Ni levels. Stem feeding was preferred to leaf feeding. This study indicates that further research is needed to evaluate the relative importance of elemental, organic, and physical defenses of Ni-hyperaccumulators in natural communities. The potential transfer of nickel from herbivores to higher trophic levels also deserves further attention.

The effects of an environmental enrichment device (EED) on the social and zoo-directed behaviors of captive Asian small-clawed otters (*Aonyx cinerea*)

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Captive animals often experience stress and exhibit abnormal behaviors such as zoo directed behaviors, aggression between conspecifics, and stereotypic behaviors. A strong body of research has developed around enrichment to encourage more natural behaviors and alleviate aggression in captive animals. We explored whether the use of environmental enrichment devices (EEDs) would alter the aggressive and zoo directed behavior in two sister pairs of Asian small-clawed otters at the Mill Mountain Zoo in Roanoke, VA. In the current study, two pairs of small-clawed otters have shown potential aggression and stereotypic behaviors in the past, and an intervention was used to address these behaviors. In the first part of our study we tested different types of EEDs for practicality, sturdiness, safety, and effectiveness. Next, we observed the otters in their separate pairs before the enrichment intervention. The otters were then observed with the EED present and then for an additional 20 minutes once the EED was removed. Results show that after the enrichment intervention, the frequency of zoo directed behaviors decreased. Instances of rough and tumble play increased, while other social behaviors decreased. The decrease in zoo directed behaviors suggests that an EED may be a suitable method to decrease such behaviors. Additionally, the increase in rough and tumble play suggests that an EED intervention might also help induce play among otters rather than aggression. This work demonstrates that an EED can be an effective method to manage abnormal behaviors and hopefully promote health in captive Asian small-clawed otters.

Monitoring the population of big brown bats in White Clay Creek Preserve, PA.

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Over the past three years Delaware Technical Community College faculty and students have been researching big brown bats (*Eptesicus fuscus*) at the White Clay Creek Preserve, Pennsylvania. Starting in early May, after the bats finish hibernating, researchers begin doing emergence counts on a maternity roost. When enough bats have returned to the roost, mist nets are used to capture bats. Measurements on the bats were done to determine the reproductive status, body mass index (ratio of mass to forearm length), and when the juveniles begin to emerge. The population of big brown bats in the preserve has been increasing and shows no indication of being affected by white nose syndrome. Using special equipment, walking transects were done along the trails of the preserve to see which habitat the big brown bats are using. The bats are found more frequently along the creeks and open areas next to tree lines.

Investigative the seasonal dietary variation of big brown bats (*Eptesicus fuscus*) using DNA barcoding.

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Most investigations of the diets of insectivorous bats have relied heavily on morphological identification of insect parts found in feces. More recently, PCR and high throughput sequencing have been used to obtain a more thorough identification of consumed insects. This study takes advantage of the advances in DNA barcoding to investigate prey choice of a maternity colony of big brown bats (*Eptesicus fuscus*) within the White Clay Creek Preserve (WCCP), PA. Amplification and cloning of insect DNA isolated from feces collected monthly revealed changing patterns in diet during the summer. Most big brown bat studies have identified predominately beetle (Coleoptera) and moth (Lepidoptera) fragments. In contrast, the majority of sequences obtained from WCCP colony guano align with crane flies (Diptera: Tipulidae and Limoniidae). Comparison of sequences between different months indicates that the bats are feeding on different Diptera families; in all probability this coincides with the emergence patterns of local crane fly populations. Concurrently with feces collection, light traps were used to sample insect communities but this method yielded low crane fly counts. Future research will focus on collecting crane flies in the preserve to correlate emergence with prey discrimination and choice of feeding habitat.

Songbird use of a capped landfill as a migratory stopover site in the New Jersey Meadowlands.

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Vegetation on capped landfills is known to provide habitat for wildlife. However, few studies have addressed songbird use of capped landfills as migratory stopover sites. Mist net surveys were conducted on a capped landfill in the New Jersey Meadowlands during the Fall migration seasons of 2008 - 2012. The surveys yielded a combined total of 13,510 captures of 76 species. Over 58 % of captures were of 10 sparrow species, the great majority of which were *Passerculus sandwichensis* (savannah sparrow), *Melospiza melodia* (song sparrow) and *Melospiza georgiana* (swamp sparrow). Nearly 25 % of the captures were of *Dendroica coronata* (yellow-rumped warbler), *Spinus tristis* (American goldfinch) and *Setophaga palmarum* (palm warbler). Changes in body mass were evaluated for individuals captured more than once within the same season during 2011 or 2012 for three of the most common species. Results revealed statistically significant trends of gain in body mass for *M. georgiana* and *D. coronata* during both years, and for *M. melodia* in 2011. Overall, this study suggests that large numbers of songbirds use capped landfills in the New Jersey Meadowlands as migratory stopover sites, and preliminary evidence suggests that most of the birds gain body mass while on the landfills. More research about the value of capped landfills as migratory stopover sites seems warranted.

The effects of ocean acidification on the occurrence and severity of otolith deformities in the mummichog (*Fundulus heteroclitus*).

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By the year 2100, it is projected that atmospheric CO₂ concentrations will rise to approximately 1000 ppm. As a result, oceanic pH levels are expected to drop 0.5 units, increasing ocean acidification. Studies have shown the ocean acidification has negatively affected marine calcifying organisms due to changes in the calcium carbonate (CaCO₃) system. Otoliths are an important structure in fish that act as an “earbone” aiding the fish in its sense of sound, balance, and acceleration. The otolith is a calcified structure that is generally composed of aragonite, a form of CaCO₃, and therefore it is thought that it may be susceptible to the effects of ocean acidification. Deformities in otoliths may affect the functioning of the inner ear because otolith function is determined by size, shape, and density. Larval mummichogs (*Fundulus heteroclitus*), an estuarine baitfish, were grown under three pCO₂ concentrations: the present atmospheric level of 380 ppm (control); the year 2100 projected level of 1000 ppm, and 2500 ppm. Results show that there are no significant differences in otolith size, occurrence of deformities, or severity of deformities in mummichogs that were exposed to increased CO₂ systems. These results may be due to the mummichog’s ability to adapt to a rapidly changing environment.

Prediction of *Dreissena polymorpha* invasion in Maryland utilizing surface water characteristics and Maximum Entropy modeling

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Although invasive species are not conceptually new, globalization has accelerated their proliferation, with humans and associated technology serving as convenient vectors for spread of larvae, seeds, and adult organisms through trade, shipping, and travel. Aquatic invaders are particularly concerning considering limited management means available. In cases of particularly virulent invasions, such as *Dreissena polymorpha*, prediction and prevention may be the most effective and least costly options available to managers. With the recent sighting of *D. polymorpha* in Maryland, constructing a presence-only model trained with surface water variables of salinity, dissolved oxygen, pH, and water surface temperature seemed appropriate. The model was tested using analytical and field survey methods.

Should Pennsylvania use *E. coli* as its standard for determining recreational water quality?

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Public health departments have used total coliform bacteria as an indicator of water quality since the early 1920's. These organisms ferment lactose to acid and gas that can then be easily and inexpensively monitored. Unfortunately, even a more restrictive fecal coliform group contains species that do not necessarily have a fecal origin, making false positive results significant. Advances in chromogenic materials that change color or fluoresce in the presence of bacterial enzymes or metabolites now allow microbiologists to easily test for one specific fecal coliform, *Escherichia coli*. Despite a 1986 recommendation by the U.S. EPA to adopt the *E. coli* standard, Pennsylvania continues to utilize fecal coliforms as the standard to determine water quality for recreational purposes. In this study we sampled water from 19 sites along the Little Lehigh Creek and its tributaries 10 times during Summer 2012. Samples were analyzed in our laboratory for *E. coli* utilizing a chromogenic-fluorescence analysis developed by IDEXX Laboratories, Inc. Replicate samples were analyzed for fecal coliforms using a membrane filtration method at an EPA-certified water testing facility. Eleven of the 19 sites produced inconclusive results based on the fecal coliform testing procedure, whereas only 4 of the 19 sites utilizing the IDEXX *E. coli* analysis were inconclusive. Variance within the *E. coli* sample dataset was significantly lower than in the fecal coliform set. Based on these results we recommend that Pennsylvania adopt *E. coli* as the standard for determining recreational water quality in the state's freshwater streams and lakes.

Defining the understory: Refinements in hemispherical photography

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Understanding and characterizing forest understory conditions is important for both agroforestry and restoration efforts. A variety of techniques and have entered use recently, with widely varying costs. One of the fastest growing techniques for canopy measurements is hemispherical digital photography. I propose two improvements to this technique, modifying protocol both in the field and during post-processing.

The precision of data from hemispherical photography is limited by the quality of the images, and image quality is greatly impacted by exposure settings. I compare image exposure across several settings to find an optimum correction for use in highly variable field conditions. Results show that limited underexposure of an image (by 3 stops) produced little to no loss of signal. By contrast, overexposing an image resulted in greatly underestimating canopy closure. We propose an update to field protocol, that under unstable canopies operators should err of the side of lesser exposure.

The use of image filters is a common technique to improve results from hemispherical photography, based on the principle of maximizing image contrast. I modified post-processing techniques to isolate individual color channels along the same principle. Blue channel images are widely accepted to have a higher contrast when comparing canopy vs. sky, and therefore was hypothesized to lead to more consistent representation of canopy structure. We verified this to be true; blue channel images provided more reliable estimates of canopy closure when compared against red, green, and RGB images.

A baseline study of the environmental attributes and the quantification of ecosystem services for DeShong Park in Chester, PA

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Alfred O. Deshong a wealthy Chester industrialist bestowed his 27-acre estate and mansion to the people of Chester, PA in 1913. Currently, the park is abandoned and has not been maintained by the city for 25 years. Although the park is open to the public it is not aesthetically pleasing and is used very little if at all for events or daily recreation. This project is designed to provide a baseline spatial assessment of the current environmental attributes of Deshong Park. These environmental attributes include the geology, hydrology, ecology, and most importantly the biological attributes of the existing trees. By studying the trees, an ecosystem service value for the park can be quantified. All of the information will be georeferenced in the field using a global positioning system (GPS) and imported to a geographic information system (GIS) to allow for spatial modeling. The spatial modeling is designed to support future restoration or conservation plans that are being developed by city officials. In addition, the impact of a restored park will be determined in terms of social benefits to the surrounding community.

Characterization of soil microbes, White Clay Creek Preserve.

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Delaware Technical Community College students are investigating the diversity of microbial communities in different soils to further understand the roles of microorganisms in the environment. The bacterial diversity within a soil sample collected from a meadow in White Clay Creek Preserve, PA (WCCP) will be used as a comparison with bacterial diversity within other soil types with differing characteristics. Our research focused on characterizing the bacteria that could grow on nutrient-rich media from the WCCP sample. We amplified the 16S ribosomal RNA gene of our isolated colonies for sequencing. Cloning was done on the WCCP soil for culture-independent analysis. The bacteria that were cultured on rich media significantly vary from what was cloned. The results from the Nutrient Agar culture plates showed that most of our colonies were *Bacillus*; while Glycerol Yeast Extract showed more *Streptomyces*. The culture-independent cloning results suggest that neither *Bacillus* nor *Streptomyces* are the main genera but are only a very small percentage of the soil microbial community. The cloning results indicated that the WCCP microbial community is highly diverse with representatives found from all major bacterial groups.

Site and soil layer variation in the microbial populations of two urban forest remnants.

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Soil fungal and bacterial communities play an important role in the carbon and nitrogen cycles of the soil. However, field research on the dynamics of soil microbial populations has been limited since these populations are highly influenced by environmental variables including soil type, moisture, pH, and temperature, which are difficult to control *in situ*. In particular, very little is known about the soil microbial community structure in urban forests. In a preliminary study to my dissertation research, I investigated the numbers of bacterial and fungal DNA copies extracted from soil cores collected within two different urban forests remnants located in Prince George's County, MD. The soil type at both sites is mesic Aquic Hapludult and the pH is ~ 4.3. Soil cores from the top 10 cm of soil were separated into organic and mineral layers for analysis. Gene copy numbers of fungal and bacterial DNA were determined using Q-PCR. There was no significant difference between the organic and mineral soil layers for either fungal or bacterial gene copy number, however the difference in bacterial and fungal amounts and the bacteria to fungi ratio differed significantly ($\alpha=0.05$) between the sites. The random variation of fungal and bacterial DNA amounts within a small area was large and the ability of this variation to mask significant sites differences should be considered when planning further research on soil communities.

Pea aphid defensive symbiont dynamics in response to parasitoid wasp.

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Molecular techniques have recently demonstrated numerous mutualisms between heritable bacterial endosymbionts and their animal hosts. The pea aphid, *Acyrtosiphon pisum*, hosts a variety of non-essential symbionts that confer important ecological traits, including thermo-tolerance and improved resistance to parasitism and fungal pathogens. Pea aphids can reach high densities on crops, and are regulated, to some extent, by the parasitoid wasp, *Aphidius ervi*. One bacterial endosymbiont, *Hamiltonella defensa*, is known to increase pea aphid resistance against *A. ervi*. Therefore, we expect that changes in wasp density will correlate with *H. defensa* frequency under natural environmental conditions. In order to test this hypothesis, aphids in PA and NY were collected from alfalfa and clover fields over nine sampling dates during the spring, summer, and fall of 2011. These samples were screened for various symbionts using a diagnostic PCR. Aphids were reared on plants in the lab to determine rates of parasitoid mortality, and sweep net sampling provided data on wasp density. *H. defensa* frequency positively correlated with wasp density in alfalfa, but not in clover populations. While wasp densities were higher in alfalfa fields, parasitoid-induced pea aphid mortality was higher for aphids from clover. This was probably a reflection of higher frequencies of *H. defensa* in alfalfa. Overall, it is likely that wasp density is driving changes in *H. defensa* frequency in alfalfa but not clover. In future work, field cage experiments will be conducted to more carefully measure the effects of *H. defensa* on wasp populations under natural conditions.

Pea aphid, *Acyrtosiphon pisum*, symbiont diversity over time and space.

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Aphids, whose populations in nature are regulated by natural enemies and abiotic conditions, are known to feed on a variety of plant species. Because of their diversity, they can reach high densities on crops such as alfalfa and clover. The pea aphid can harbor one or more of seven known heritable secondary symbionts that can provide ecological benefits such as thermotolerance, defense against parasitoid wasps and fungal pathogens, and host plant utilization. Variable environmental conditions may influence symbiont presence which can impact genetic diversity. This could explain the high variety of secondary symbionts in the pea aphid. To better understand the relationship between biotic and abiotic seasonal changes and the prevalence and diversity of these symbionts, aphids were collected from alfalfa and clover in New York and Pennsylvania over nine sampling dates. Using PCR, the infection status of over 900 pea aphid samples was determined by testing for six known secondary symbionts. It was expected that symbiont frequencies would differ in correlation to changing environmental conditions. An average of 1.7 to 2.3 symbionts per aphid was discovered on clover and alfalfa, respectively. .. Observed co-infection frequencies, combinations of certain symbionts per aphid, occurred more often than expected. Also, high multiple infections were observed on several dates in alfalfa. These data suggest that multiple infection status varied over time and space and may provide benefits to pea aphids under certain environmental conditions. Few studies have analyzed the fitness costs or benefits of multiple infection, suggesting a clear need for further investigation.

Notes on the diversity and foraging height of carrion beetles (Coleoptera: Silphidae) of the Nassawango Creek Preserve, Maryland, USA

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Most Silphidae are scavengers of carrion or other decaying material. Previous studies have reported 18 species of silphids found in Maryland. This research used baited hanging pitfall traps to examine the species diversity of carrion beetles in two habitats (forest and field) of the Nassawango Creek Nature Conservancy Preserve in Maryland, USA. In addition, foraging height was examined at two heights (0.5 m and 2.5 m) to study vertical distribution along with seasonality. A total of eight species was captured with most species preferring the forest habitat and 0.5 m ground placed traps. Just one species, *Nicrophorus pustulatus*, showed a preference for foraging at higher elevations. This is congruent with previous studies reported for this species.

Illustrated keys to the Scarabaeinae (dung beetles) of Maryland

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The taxonomic community is aware of the diversity and ecological importance of dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae). Currently, however there is no comprehensive guide to this subfamily in Maryland, or to the Mid-Atlantic Region. The purpose of this project is to create up-to-date taxonomic keys for all Maryland species and to include original illustrations and photographs, for the identification of Maryland dung beetles. These keys will serve as a resource for which identifications can be made by both experts and novice beetle enthusiasts. This research will contribute to scarab Citizen Science research currently conducted in our lab, as well as a taxonomic guide to the Scarabaeoidea of Maryland.

Dung beetles and their gut endosymbionts.

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Dung beetles (Coleoptera: Scarabaeidae and Geotrupidae) play a crucial role in the rapid degradation of animal excrement and are considered both ecologically and economically important for their use in the biocontrol of dung and dung-associated pests. Dung, however, is considered a nutritionally poor resource consisting primarily of cellulose and lacking in several essential amino acids. Amazingly, these beetles use their gut microbiome to supplement their diet and aid in digestion. The proposed research has two main objectives: 1) Use standardized baited pitfall trap transects to examine the dung beetle diversity and abundance on organic and conventionally managed dairy cow farms across Maryland. We will also examine individual dung pats using a scaling system to rank abundance of individual species. These data will be used to create an efficient scaling system that farm managers may use to assess dung beetles on their farms. 2) Make collections of *Onthophagus taurus* from organic dairy cow farms across Maryland to examine their gut microbiota. Using sequence tags attached to PCR Primers, we will amplify and sequence 16S rRNA V3 and V5 regions. This will allow us to examine microbiome diversity of different beetle populations and to determine if they possess a core set of gut endosymbionts across Maryland.

Native bees in the N.J. Pinelands: Diversity and habitat relations.

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Even though concern is spreading about worldwide pollinator decline, much is still unknown about native bee populations and their density, abundance, and diversity. The New Jersey Pine Barrens are a highly distinctive ecosystem whose native bees have not been thoroughly sampled. We established fifteen transects in New Jersey Pinelands monthly from May to October, 2012. To conduct this survey, thirty bee bowls, alternating blue, white and yellow, were placed at each site for at least twelve hours, from morning to evening. Bowls were filled with water and a few drops of blue dawn dish detergent. Specimens were preserved in 80% ethanol, then washed, dried and pinned.

We found fifty-seven species, varying by season and study site. Over half belong to the family Halictidae. Additional species are awaiting expert identification. The greatest diversity was found during June at the Richard Stockton College site. Three of the species are rare deep-soil borers, and we plan to further investigate their habitat relations, using our Geographic Information System (GIS) to compare vegetation and soils of the transect areas and possibly LIDAR data on micro-topography.

Our initial surveys have detected the presence of at least four poorly-documented species. Deep sands are a notable feature of certain areas in the Pine Barrens, and may support a number of plant and animal species unlikely to be found elsewhere. This will be a long-term effort to understand the status of native pollinators in the Pine Barrens.

Comparison of genetic variation in healthy and diseased populations of the old-field grass *Andropogon virginicus*

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Some natural plant populations may exhibit epidemic levels of disease while other populations of the same host species appear disease-free. Host population genetic structure may contribute to this variation in disease prevalence. Genetically homogeneous populations should be more likely to host disease because a pathogen that successfully infects a population with few, common host genotypes can spread easily and/or can readily evolve virulence on the common genotypes. We studied healthy and infected populations of *Andropogon virginicus* (broomsedge), a common old-field grass in the eastern U.S, where 50% of populations are infected with the smut fungus *Sporisorium ellisii*. This pathogen reduces or eliminates reproduction and increases mortality of *A. virginicus*, which also could result in lower host variation in diseased populations. We extracted DNA from plants grown from field-collected seed, did PCR for ISSR markers on 20 individuals each from three healthy and three infected populations, and calculated percent polymorphic loci and Nei's gene diversity for each population. Percent polymorphism ranged from 33-67% in the healthy populations and 42-50% in the infected populations, with no significant difference (means: healthy = 50%, infected = 47%). Gene diversity ranged from 0.10-0.15 in the healthy populations and 0.08-0.16 in the diseased populations, again with no significant difference (means: healthy = 0.12, diseased = 0.11). Infection of populations by *S. ellisii* appears not to be related to host genetic variation, although planned additional markers and populations will provide more information. Environmental variables may be stronger drivers of disease development in this system.

Caterpillar host plant choice and parasitoid infection rates: An investigation in tri-trophic interactions.

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Caterpillar host plant choice can affect parasitoid infection rates of caterpillars through sequestration of host plant allelochemicals by caterpillars, or by plants attracting parasitoids through chemical signals as a defense against herbivory. In this study, we measured the frequency of parasitoid infection of *Epimecis hortaria* caterpillars on four host plant species (*Lindera benzoin*, *Asimina triloba*, *Liriodendron tulipifera*, and *Sassafras albidum*) to determine if caterpillar host plant choice affected rates of infection by parasitoids. We also georeferenced parasitized and unparasitized caterpillars and imported the collection locations to a GIS system. Geoprocessing techniques and spatial statistics were used to investigate any correlations between the parasitism results and other environmental attributes of the study location. Caterpillars were field collected from Alapocas Run State Park in Wilmington, Delaware and monitored daily for evidence of parasitoid infection until pupation. Caterpillars infected by parasitoids were collected exclusively on *L. benzoin* and *A. triloba*, indicating a significant relationship between caterpillar host plant species and presence of caterpillar parasitoids ($\chi^2=12.676$, $n=83$, $p<0.01$). This may indicate that parasitoid adults prefer caterpillars feeding on *L. benzoin* and *A. triloba* when choosing hosts for their offspring, or an inability of parasitoid larvae to successfully survive in hosts feeding on *L. tulipifera* and *S. albidum*. Additional caterpillars will be collected and examined for parasitoid infection in summer 2013 and we plan to complete a spatial analysis of the relationship between caterpillar location, parasitism, and other selected environmental attributes.

Assessment of IPM hub strategy on the Dickinson College Farm

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Increasing human health concerns, predicted growth of insect populations due to global warming, and increasing prevalence of pesticide resistance in insects have led to a recent surge of interest in alternatives to traditional, broad-spectrum chemical pesticides. One proposed alternative is the modification of agricultural landscapes to create habitat for beneficial insects, natural predators and parasites of pest insects. During the 2011-2012 academic year the Dickinson College Organic Farm created a series of six hubs, small ponds surrounded with native, flowering vegetation to attract and shelter insect predators and parasites. In order to assess the effectiveness of these hub habitats, a variety of tests were implemented including: comparison of families of insects found in hub vegetation with those targeted in planting; plotting of parasitized and non-parasitized tomato hornworms in tomato fields adjacent to ponds; and a series of transects, consisting of sweep net sampling, pitfall, and sticky traps, to determine the influence of ponds on spatial distribution of insects. Testing of hub vegetation showed goldenrod and cosmos to attract the greatest diversity and density of beneficial insects. Plotting of parasitized tomato hornworms showed no significant correlation ($R^2 < 0.2$) between distance from hub ponds and the presence of parasitic wasps. Results of transect data do not suggest a pattern. From this research, it appears that further modifications will be necessary in order for these ponds to become an effective means of pest control.

Evaluation of earthworm communities and the effects on forest diversity dynamics in Southwestern Virginia.

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Non-native species pose serious threats to native communities and are a top cause for species endangerment worldwide. We study the exotic earthworm community dynamics and their correlation with forest diversity in Southwestern Virginia. Specifically we examined the predictions that (1) site characteristics (closeness to water, patch size, and topography) would alter earthworm species composition, and (2) amount of recent rain would affect “apparent” earthworm communities, and (3) that earthworm diversity and population size would be correlated to level of disturbance in the plant communities. We surveyed plant and earthworm communities in 10 forests from 2008 to 2012. These sites ranged from small suburban fragments (<10 ha) to large nature reserves (5,100 ha). First, we found that earthworm communities in our study sites appear to be comprised solely of exotic species. Second, we tended to find earthworm species composition dominated by bait species (*Lumbricus sp.*) close to waterways. Lastly, we found higher diversity of earthworms and higher population sizes in areas that had higher tree species diversity. Higher tree species diversity may be related to recent disturbance histories. Taken together, our results suggest that human activities including disturbance have greatly altered earthworm communities in Southwestern Virginia shifting them from native to exotic species.

Invasion meltdown: role of non-native species *Alliaria petiolata* and *Lumbricus terrestris* on native species dynamics

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Herbaceous invasive species and non-native earthworms continue to spread across the United States. Where they come in contact, they potentially may be altering the environment producing a synergistic effect on native plant populations. In a greenhouse experiment, we examined the interactive effects of garlic mustard, *Alliaria petiolata*, and common night crawlers, *Lumbricus terrestris*, on the populations of three native plant species: *Cassia fasciculata*, *Rudbeckia hirta*, and *Elymus virginicus*. Specifically, we tested the prediction that *Lumbricus* and *Alliaria* treated soil would each reduce native plant germination and biomass. And together, *Lumbricus* and *Alliaria* would have a synergistic negative effect on native plant germination and biomass. We grew the three native species in single-species, 4L pots in the following factorial design of +/- soil that garlic mustard had grown in, +/- *Lumbricus*, +/- activated carbon to absorb the *Alliaria* allelochemicals. We had six replicates of each treatment combination. Results to date demonstrate that *Lumbricus* reduced *Rudbeckia* germination and activated carbon increased germination particularly for seedlings grown in garlic mustard soil (3-Way Factorial ANOVA $P < 0.01$; with significant 3-Way Interaction $P < 0.01$). *Alliaria* soil reduced *Elymus* germination (One-Way ANOVA $P < 0.05$). *Alliaria* soil is more likely to affect biomass than germination because these species likely rely heavily on mycorrhizal association during growth. These invasive species do indeed appear to interact producing negative synergistic effects on some but not all native plants; perhaps due to species-specific nutrient dynamics.

**Comparison of genetic variation in native and non-native populations of the grass
*Andropogon virginicus***

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Introduced populations may be less genetically variable than native populations because of the founder effect. Alternatively, if they are invasive and spread widely, they may be more variable, allowing them to exploit a wide range of environments. We examined genetic variation in native and non-native populations of *Andropogon virginicus* (broomsedge), a common grass native to the eastern U.S., which is naturalizing in California's Central Valley and invasive in Hawaii. We extracted DNA from plants grown from field-collected seed, and conducted PCR using ISSR primers on 20 individuals each in 3-6 populations from each region. We calculated percent polymorphism and Nei's gene diversity for each population. Native populations had somewhat higher percent polymorphism (means: native, 48.6%; California, 35.4%, Hawaii 38.9%), and included the highest value (66.7%). The lowest value was in California (25%). However, ANOVA did not detect significant variation among the regions ($P=0.11$). The gene diversity results showed that populations from California were somewhat less variable (means: California, 0.09; Hawaii, 0.13; native, 0.12), but the regions were not significantly different ($P=0.18$). These results suggest that Californian populations may be less diverse than other populations (additional data will provide more information). This may be due to a founder effect, but in the seasonally dry Central Valley, *A. virginicus* is restricted to lakeshores, riparian corridors, etc., which may have selected for a narrow range of genotypes. In remote Hawaii, where a strong founder effect might be expected, it grows in variable niches ranging from xeric lava flows to pastures and submontane forests.

Interactive effects of the invasive *Amyntas* sp. and *Alliaria petiolata* on native plant population dynamics

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The *Amyntas* earthworms are extremely destructive East Asian invader that is already established in a minimum of four eastern states. It has the potential to spread across the country affecting native communities. This species are sold as red wriggler earthworms for backyard earthworm composters. Another threat to native plant diversity in the Mid-Atlantic region is the continual spread of the European invader: garlic mustard, (*Alliaria petiolata*). To better understand the potential interactive effects of these two invasive species on the wide spread native plant *Rudbeckia hirta*, we conducted a greenhouse experiment where we tested the following predictions. 1) *Amyntas* will decrease germination and growth due to their epigeic nature disturbing the seeds and the establishment of root growth. 2) Soil that *Alliaria* had grown in will decrease growth because the allelopathic effects of *Alliaria* on mycorrhizal mutualists of *Rudbeckia*. 3) The combined effects of *Amyntas* and *Alliaria* soil will have a negative synergistic effect *Rudbeckia* biomass. Preliminary results demonstrate the presence of *Amyntas* and *Alliaria* soil does not decrease germination. As *Amyntas* earthworms start to spread across the country being able to predict their affects in communities already invaded by *Alliaria* will be important for managers.

A novel defense? Understanding the plant competition role of the enzyme polyphenol oxidase in the invasive genus *Bromus*

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Ecosystems are increasingly susceptible to biological invasions and much theory and research focus on which factors promote such invasions. The “novel weapons” hypothesis is one proposed mechanism that suggests invasive plants exude allelochemicals that are unknown to the native populations and therefore cannot be readily defended against. A possible defense mechanism that can be invoked by plants is the enzymatic destruction of the allelochemical compounds before they can exert their toxic effects. It has been shown that seedlings of the genus *Bromus* constitutively possess high levels of a polyphenol oxidase (PPO). We hypothesized PPO may be used as a “novel defense” against allelopathic invading species such as *Centaurea sp.* and *Artemisia sp.* because many of the allelochemical compounds serve as substrates for PPO. Accordingly, we examined ecological impacts of PPO and non-PPO-producing grasses grown with and without allelopathic forbs collected in New Jersey. Results indicate that (a) the PPO-producing grass *Bromus inermis* produced a greater number of leaves, longer leaves, and greater root mass when grown with allelopathic phenolic-producing forb *Centaurea stoebe* than conspecifically, and (b) both root and shoot growth was suppressed in non-PPO producer *F. rubra* when grown with *C. stoebe*. This supports our hypothesis and indicates an interaction between *B. inermis* and *C. stoebe*. When either *B. inermis* or *F. rubra* was grown with *Artemisia vulgaris* both shoot and root growth was suppressed. Future plans include growing *B. inermis* and *F. rubra* with partially decomposed biomass of *C. stoebe* and *A. vulgaris* and additional observational field studies.

Comparing brownfield and old-field floras of New Jersey: Do non-native plants make up a higher proportion of brownfield floras?

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Plants that grow in urban and post-industrial areas need to cope with conditions that are by-products of intense human activities. Brownfields are sites characterized by high levels of industrial by-products: hazardous substances, pollutants, or contaminants. Old fields are abandoned agricultural fields; they are also anthropogenic, but do not typically have significant contamination. Due to a difference in industrialization timeline between Europe and North America, European plants may be better adapted to conditions present in urban brownfields. To explore the hypothesis that some non-native plant species are pre-adapted to brownfield environments, and both non-native and native species are adapted to old-field conditions, we sampled vegetation at five brownfield and five old-field sites in central and northern New Jersey using three Whittaker plots along a 100 meter transect. The species richness for old fields ranged between 24 and 48, and from 24 to 42 for the brownfields. Three out of five old-field sites had over fifty percent native species. Only one brownfield site had over fifty percent native species. The one brownfield site with high percentage of native species and the two old-field sites with lower percentages of native species had the three lowest total species. These preliminary results give support to the hypothesis that some non-natives may be pre-adapted to brownfield conditions. Further directions include analysis of percent cover data, soil samples, and landscape variables. Field transplants and greenhouse experiments are planned using the most common native and non-native species from the surveys.

***Arabidopsis* scaffold protein RACK1A regulates diverse environmental stress signaling pathways.**

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RACK1 (Receptor for Activated C Kinase 1) is a WD-40 scaffold protein, conserved in eukaryotes. In the model plant *Arabidopsis thaliana*, the genome maintains three different *RACK1* genes termed *RACK1A*, *RACK1B*, and *RACK1C* with a very high (85-93%) sequence conservation. Loss of function mutants in *Arabidopsis* indicate that RACK1 proteins regulate environmental stress signaling pathways, namely the drought stress resistance pathway. RACK1A- the predominant isoform, is found to interact with diverse environmental stress related proteins. Deduced crystal structure of RACK1A indicates that post-translational modifications like sumoylation and phosphorylation can regulate its function. Tyrosine phosphorylation on residue 248 is found to regulate its homo-dimerization capacity as well as its interactions with other proteins (Kundu et al., 2013). Small compounds inhibiting Y248 phosphorylations are isolated and the effectiveness of the compounds in regulating diverse environmental stress responses by the model plant *Arabidopsis* are evaluated. Here we present evidence that the compounds are effective in regulating salt and drought stress responses in *Arabidopsis*.

Kundu N., Dozier U., Deslandes L., Somssich IE, Ullah, H (2013). *Arabidopsis* scaffold protein RACK1A interacts with diverse environmental stress and photosynthesis related proteins. *Plant Signal Behav.* May 2013 Vol 8 (5)

Analyzing the spatial distribution of ash trees (*Fraxinus*) at the Bucks County Audubon Society's Honey Hollow Conservation property to quantify the loss of ecosystem services by potential predation of the emerald ash borer (*A. planipennis*)

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The emerald ash borer (EAB) is a beetle native to Asia and is responsible for the current decline of the Ash tree population in the United States after it was first discovered in Michigan in 2002. This project examines the ash trees on the western side of the Bucks County Audubon Society's Honey Hollow Conservation Property, as well as, the migration patterns of the Emerald Ash Borer toward the property. The project includes research on the biology and life cycle of the emerald ash borer insect, ecological benefits of ash trees, and confinement and remediation techniques. Ash trees in the study area have been identified, and the points were georeferenced using a Global Positioning System (GPS). The survey assesses any current damage and quantifies the possibility of future damage using a Geographic Information System (GIS). Data collected on the ash trees will allow the project to quantify the ecosystem services provided by the trees and therefore provide an ecological impact analysis if the trees were to be lost. Several interpolation methods were used to create surfaces and analyze areas most susceptible to invasion from the EAB and the most important to protect. This data can be used to support a risk assessment management plan for the Bucks County Audubon Society-Honey Hollow Conservation Property to help protect against the future arrival of the emerald ash borer.

Quantifying the changes in ecosystem services from a shade tree project in an urban park in Chester, PA from 2009 to 2013.

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Chester Park is an urban park in the city of Chester, PA. As the human population and development continues to increase, these urban parks become more important for the ecosystem services they provide. Trees help offset and mitigate air and water pollution, storm water runoff, strong winds, and heat islands; effects that are intensified by cities. Chester Park's landscape between 2009 and 2013 has changed as a result of a shade tree planting program. In 2009, trees were surveyed and georeferenced using a Global Positioning System (GPS) in the open areas of the park to spatially analyze and map the distribution of tree attributes. Since 2009, there have been several large trees removed because they posed a potential danger to residents and many new trees have been planted throughout the park. This project's goal is to quantify the change in ecosystem services provided by shade trees in Chester Park from 2009-2013 and develop an overall ecosystem value for Chester Park to support the ongoing conservation efforts initiated by the city of Chester.

Determining the effect of higher atmospheric [CO₂] on the symbiotic relationship of *Sinorhizobium meliloti* and alfalfa

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Alfalfa (*Medicago sativa*) plants, establish a symbiotic relationship with *Sinorhizobium meliloti* to obtain a new source of nitrogen that allows them to thrive in nitrogen poor environments. The plant forms nodules that the bacteria inhabit. In the nodules, the bacteria transform molecular nitrogen from the air into ammonia, a form of nitrogen the plant can use. The purpose of this project is to determine if higher levels of atmospheric CO₂ concentrations affect symbiosis. We are monitoring the number of nodules, shoot biomass, nitrogen fixation efficiency and nodule structure under conditions of ambient (400 ppm) and elevated (900 ppm) levels of carbon dioxide. We are also assessing whether two *S. meliloti* mutants (*nodL* and *phbA*) are affected in a similar way as the wild type (Rm1021). To evaluate nodule number, nodule structure and shoot weight, we are growing plants in nitrogen-free medium at ambient CO₂ concentrations or at elevated CO₂ concentrations, inoculating them with the *S. meliloti* strains, monitoring nodule number weekly, and harvesting them after 2 or 4 weeks. To evaluate nitrogen fixation efficiency some plants are grown in medium with isotopically labeled (¹⁵N) ammonium nitrate. The nitrogen isotope labeling will allow us to estimate the proportion of nitrogen that is being fixed by the rhizobia as a measure of nitrogen fixation efficiency. Preliminary results showed an increase in shoot mass but a decrease in nodule number when plants inoculated with the wild type were exposed to elevated CO₂ concentrations. In contrast, the *phbA* mutant exhibited an increase in both shoot biomass and nodule number. Experiments to confirm these results, and to evaluate nodule structure and nitrogen fixation efficiency are underway.

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