NORTHEAST PARTNERS IN AMPHIBIAN AND REPTILE CONSERVATION

2019 Annual Meeting – July 17 to July 19

Stockton University, New Jersey

STOCKTON UNIVERSITY

FEATURED PRESENTATION ABSTRACTS

Liz Willey, PhD, Antioch University/American Turtle Observatory (ATO)

Leveraging 20 Years of NEPARC Partnerships: Where from Here for Turtle Conservation?

ORAL PRESENTATION ABSTRACTS

(in order of presentation)

Title: Collaborative Conservation Planning in the Northeastern United States: Regional Conservation Needs Grant Program

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Abstract: The management and implementation of conservation actions can often be inhibited when the distribution of a species crosses multiple government jurisdictions. In the United States, the Northeast region of the Association of Fish and Wildlife Agencies (NEAFWA) and Region 5 of the U.S. Fish and Wildlife Service (USFWS) is comprised of 13 states and the District of Columbia. Distributed within this region are 21 species of fresh and brackish water turtles, twenty of which are listed in at least one State Wildlife Action Plan (SWAP). To address the need of range wide conservation actions and coordination, the NEAFWA, the USFWS, and the Wildlife Management Institute partnered in 2007 to create the largest multi-jurisdictional collaborative in the United States: the Northeast Regional Conservation Needs Grant Program (RCN). Recognizing shared elements of SWAPs, participating states agreed to pool 4% of their respective State Wildlife Grant apportionments to fund cooperative projects that impact regional-level conservation and restoration initiatives that extend beyond state borders. The central goal of the RCN program is to develop, coordinate and implement conservation actions that are regional or sub-regional in scope, to build upon the multiple regional initiatives that already exist and complement ongoing work in individual states. Specifically, RCN projects produce 1) unifying maps of the target region's habitats, 2) common language and condition analysis of those habitats, 3) identification of regional conservation focus areas (what they are and where they are), and 4) consistent metrics to measure success and gauge effectiveness.

Title: What Keeps Me Up at Night? Thoughts on Improving the Long-term Outlook for Turtles and Other Herpetofauna

Author(s): Kurt A. Buhlmann, Savannah River Ecology Laboratory, University of Georgia, Aiken, South Carolina 29802 USA; kbuhlmann@earthlink.net

Abstract: Finding solutions to conservation problems has never been more challenging. As an environmental studies college student is the 1980s, I naively thought that after a career in wildlife conservation, we would-by now- have fixed many of the

endangered species problems. Alas, there are more. Regulations, permitting, surveys, monitoring programs, workshops, and environmental education all have valuable roles to play. However, for many species, including many reptiles and amphibians,

we are way past the time of "conservation", where conservation seems to mean "conserving what we have left." What we have left is not enough, and this talk seeks to engage conversation not about conservation, but about species "recovery." There are numerous recovery methods and concepts, including assurance colonies, headstarting, and reintroductions that need to be coordinated with habitat protection and aggressive habitat restoration. These arguably more risky population manipulations must be investigated with good science, seriously discussed among policy makers and regulators, and appropriately integrated into programs to *increase* the numbers of viable populations on the landscape.

Title: Ecotoxicology Effects of Microplastics In Freshwater Wetlands

Author(s): Aaron. B. Stoler, School of Natural Sciences and Mathematics, Stockton University, Galloway NJ 08205; aaron.stoler@stockton.edu

Abstract: There is increasing evidence for the detrimental effects of microplastic on aquatic consumers. However, far less research has focused on the ecotoxicological community effects of microplastics. I hypothesized that the effects of microplastic pollution on aquatic communities will vary by type of plastic and will be most detrimental among plastics with high volatility (e.g., PVC). To test this hypothesis, I conducted an outdoor mesocosm experiment in 100-L wading pools. I added one of six microplastic types, including the six most commonly used compositions: PVC, polypropylene, PET-G, LDPE, HDPE, and polystyrene. I added microplastics at two environmentally relevant concentrations for a total of 12 treatments and a no-plastic control. Mesocosms contained leaf litter, microbes, algae, zooplankton, snails, amphipods, and tadpoles. In contrast to my hypothesis, I found that microplastics had positive or neutral effects on community members. I suggested that these effects might result from plastic providing a substrate for biofilm growth.

Title: Don't Tread on Me: An Examination of the Anti-Predatory Behavior of Eastern Copperheads (*Agkistrodon contortrix*)

Author(s): Andrew Adams*, STEM Division, Harford Community College, Bel Air, MD 21015; Susquehannock Wildlife Society, Darlington, MD, 21034; andy@suskywildlife.org; John Garrison, Susquehannock Wildlife Society, Darlington, MD, 21034; johncgarrison@hotmail.com; Scott McDaniel, Susquehannock Wildlife Society, Darlington, MD, 21034; scott@suskywildlife.org; Emily Bueche, Susquehannock Wildlife Society, Darlington, MD, 21034; em.bueche@gmail.com; Hunter Howell, Department of Biology, University of Miami, Coral Gable, FL 33146; hjh59@miami.edu.

Abstract: Venomous snake species across the globe have been historically categorized as aggressive and dangerous, leading to widespread persecution and killings. Despite the conservation importance of educating the public about the docile nature of these species, few studies have attempted to quantify the response of viperid species to human interactions. Here we report the responses of free-ranging copperheads to a potential human encounter using a set of hierarchical behavioral trials. Out of a total of 69 snakes, only 2 individuals feigned striking and only 2 attempted to bite (3% of all individuals). Our results support the findings of previous studies documenting the docile nature of other viperid species and can hopefully be used to change the public perception of venomous snakes. Convincing the public and policy makers that viperid species are docile is critical to long-term conservation of these species in the U.S. and around the globe.

Title: Predators Induce Morphological Changes in Tadpoles of *Hyla andersonii*

Graduate Student Author(s): Ariel Kruger*, Department of Ecology, Evolution, and Natural Resources, Rutgers University, 14 College Farm Road, New Brunswick NJ 08901; ariel.kruger@rutgers.edu; Peter J. Morin, Department of Ecology, Evolution, and Natural Resources, Rutgers University, 14 College Farm Road, New Brunswick NJ 08901; peter.morin@rutgers.edu

Abstract: Predators can affect the development, fitness, and survival of prey species in myriad ways. In response to the threat of predation, tadpoles can alter growth rate, phenotype, and foraging behavior. In particular, changes to tadpole development have the potential to alter life history characteristics beyond metamorphosis and are therefore of interest in species of conservation concern. Using experimental mesocosms, we explored how non-lethal predators affected the larval development of the Pine Barrens tree frog, *Hyla andersonii*, a near-threated species in the United States. Predator-induced changes in morphology occur in some hylid tree frogs, but had not been explored in *H. andersonii*. We found that caged dragonflies (*Anax junius*) induced darker tail coloration and deeper tail fins in *H. andersonii* tadpoles, but did not affect tadpole activity level, survival, or size at metamorphosis. These findings support the existence of an adaptive syndrome among hylid tadpoles, where tadpoles express tail flagging in response to larval dragonfly predators.

Title: How Salt Tolerant Are Amphibians? Insights from a Spotted Salamander (*Ambystoma maculatum*) Population That Breeds Next to the Open Ocean

Author(s): Stephen Ressel, College of the Atlantic, 105 Eden Street, Bar Harbor, ME 04609; sressel@coa.edu

Abstract: The effect of elevated environmental salt on amphibian populations has been the focus of numerous recent studies, primarily in the context of more widespread application of road deicing salt or in the case of coastal populations, rising sea levels. To better understand the ecological and physiological factors that underlie salt tolerance, or lack thereof, in Spotted Salamanders (*Ambystoma maculatum*), I have been studying a population in Acadia National Park, ME that breeds in coastal pools subject to salt loads from the ocean that, at times, can approach full strength sea water (≈ 30-33 ppt). Here I report on my findings to date that address 1) level of site fidelity exhibited by breeding adults, 2) salt tolerance in adults from this population, and 3) larval developmental rates in relation to salinity levels. Between 2017-2019, the percent of individuals marked in a given year with Visible Implant Elastomer tags that returned in subsequent years ranged from 8-30%, implying high turnover in breeding adults between years. In the lab, I employed behavioral aversion tests to assess level of salt tolerance in coastal breeding salamanders vs. salamanders that breed in woodland pools with salinity levels <1 ppt. For both populations, 17.5 ppt represented the threshold at which salamanders spent statistically significant less time in test solutions of saline water compared to a freshwater control, suggesting no local adaptation to elevated salt in the coastal population. Finally, qualitative assessment of larval growth in coastal pools suggests that developmental rates vary widely irrespective of salinity levels.

Title: Notable and Unusual Observations of Bog Turtles (*Glyptemys muhlenbergii*) from Long-term, Intensive Studies at Three Northeast National Wildlife Refuges

Author(s): Colin P. Osborn*, U.S. Fish and Wildlife Service, Lenape National Wildlife Refuge Complex, Stroudsburg, PA 18360; colin_osborn@fws.gov; Michael T. Horne, U.S. Fish and Wildlife Service, Lenape National Wildlife Refuge Complex, Sussex, NJ 07461; michael_horne@fws.gov

Abstract: The Federally threatened bog turtle (Glyptemys muhlenbergii) is known to occur in only three National Wildlife Refuges (NWRs) in the U.S. Fish and Wildlife Service's northeast region (Region 5) and within the entirety of the northern

population of the species. These three NWRs are part of the Lenape National Wildlife Refuge Complex and lie within Pennsylvania and New Jersey. Bog turtle conservation work has been a high priority at all three NWRs and intensive studies

and management have occurred at several Pennsylvania sites for 6 years and several New Jersey sites for 7 to 15 years. Populations studied have ranged from a single individual to the highest known density in the northern range of the species, from newly discovered to prior research from decades earlier, and everything in-between. Standard Phase II (visual) and III (trapping) bog turtle survey methods have been employed, along with one instance of random encounter. Mark-recapture and radio-telemetry studies have been utilized to collect information on survivorship, behavior, habitat usage, home range sizes, hibernaculum selection, nest site selection by females, etc. As a result of these long-term, intensive studies many exceptional observations have been made, including confirmation of +50 year longevity, two juveniles attempting to use an old truck rim and tire for a hibernaculum, an old female taking a near 300m nest site trek, another old female making 650m trips each spring from and each fall to her hibernaculum for multiple consecutive years, and two young male individuals making 3.2km and 6.4km migrations, respectively.

Title: Long-distance and Fine-scale Movements of Wood Turtles (*Glyptemys insculpta*) in Virginia and Minnesota

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Abstract: Little is known about long-distance dispersal movements in freshwater turtles, despite the probable importance of such movements for gene flow between populations. There is a pressing need to better understand these movements, especially within the context of an increasingly fragmented landscape. This study aimed to look at these and other long-distance movements by tracking wood turtles (*Glyptemys insculpta*) using miniaturized GPS units attached to their shells. The data were also used to estimate home range sizes and movement speeds using powerful new statistical techniques, as well as to analyze the shift in these metrics throughout an active season. In total, 61 wood turtles (38 females, 23 males) were tracked for one to three years each, with hourly or sub-hourly locational fixes recorded for the duration of the active seasons. Two datasets, one from Minnesota (n=25) and one from Virginia (n=36), were combined for a total of over 140,000 GPS locations. Our results show that traditional measures of home range significantly underestimated actual home range sizes. Both home range size and movement speed for females increased during the nesting season while range-resident males showed much less variation. We captured numerous long-distance nesting movements, two long-distance relocation movements following flood displacement events, and two long- range dispersal events by younger male turtles. Our data demonstrate the magnitude (>13 km) and the danger of dispersal movements. It also indicates the potential of modern GPS technology for studying turtle movement and points toward the need for further studies with more individuals over longer timeframes.

Title: Examining Movements of Juvenile and Adult Diamondback Terrapins (*Malaclemys terrapin*) Using Novel Radio Telemetry Methods

Author(s): Brian Williamson*, The Wetlands Institute, Stone Harbor, NJ, 08247; bwilliamson@wetlandsinstitute.org; Lisa Ferguson, The Wetlands Institute, Stone Harbor, NJ, 08247; lferguson@wetlandsinstitute.org.

Abstract: Understanding movements and habitat use of diamondback terrapins (*Malaclemys terrapin*) is important for the conservation of the species. However, terrapin movements, particularly juveniles, remain understudied in southern New Jersey. In summer 2018, we began a long term study of juvenile and adult terrapin movements in southern New Jersey salt marshes using novel telemetry techniques incorporating passive and active digital radio telemetry using battery powered radio transmitters for juvenile terrapins and GPS/ULR transmitters for adults. Radio transmitters were attached to 4 wild and 22 head-started juvenile terrapins in 2018, with 30 additional transmitters to be deployed in 2019. To track juvenile movements, we installed 20 receiver nodes in a grid, spaced 200 meters apart, at the study site. Nodes transmit detection data to a base station receiver for storage and retrieval. Locations of animals within the grid were approximated using the average coordinates of nodes detecting them, as well as relative signal strength received by each node. Telemetered juvenile terrapins were also tracked using a hand- held antenna to ground truth node-estimated locations and collect detailed habitat and behavior data. Additionally, by the end of summer 2019 we will have equipped 10 adult female terrapins with solar powered GPS/ULR transmitters, which collect and transmit fine-scale location data to our base station. Work is ongoing, but preliminary results suggest juveniles spend time buried in mud near small tidal creeks, that the extent of juvenile movements vary by individual, and that GPS/ULR transmitters can be an effective method to study adult diamondback terrapin movements.

Title: Enforcing laws and rules protecting reptiles and amphibians against illegal trafficking in Eastern North Carolina through a variety of law enforcement methods

Author(s): Lieutenant Mark Cagle and Captain Robert Wayne, North Carolina Wildlife Resources Commission.

Abstract: Through changing demographics, heightened officer awareness and a new direction demonstrated through our agency strategic plan, we have made numerous key reptile and amphibian cases on the State and Federal levels. Incorporating law enforcement techniques normally used in game animal violator apprehension, paired with a cooperation from the U.S. Fish and Wildlife Service, subjects involved in the illicit reptile trade in North Carolina have been successfully prosecuted. Cases involving spotted turtles and red pigmy rattlesnakes highlight our success; however, other species are also being collected for the international food and pet trade. With an estimated 80% of the 90 freshwater turtle and tortoise species in Asia currently threatened, the market has moved here. The major reptile cases we have made, and training highlights will be presented.

Title: Field, Laboratory, and Statistical Considerations When Using Environmental DNA to Detect Amphibian Pathogens

Author(s): James T. Julian*, Division of Mathematics and Natural Science, Penn State University-Altoona College, Altoona, PA 16601; jtj2@psu.edu; Gavin W. Glenney, Northeast Fishery Center, U.S. Fish and Wildlife Service, Lamar, PA 16848; gavin_glenney@fws.gov; Christopher B. Rees, Northeast Fishery Center, U.S. Fish and Wildlife Service, Lamar, PA 16848; christopher_rees@fws.gov

Abstract: Environmental DNA (eDNA) can be a cost-effective means of detecting amphibian pathogens in bodies of water but this effectiveness can be influenced by the way samples are collected in the field, how they are tested in the laboratory, and the statistical models used to analyze diagnostic results. The probability of detecting a pathogen in an infected body of water is the product of the likelihood that pathogen DNA is captured on a sampling filter and the probability the captured DNA is successfully detected in a diagnostic test (*e.g.,* PCR reaction). If an investigator can estimate these two probabilities they can determine the appropriate number of eDNA samples to collect at a body of water (field effort) and the appropriate number of diagnostic tests on each sample (diagnostic effort) to achieve a desired level of confidence that negative test results are indicative of pathogen absence. We will explain how multi-scale occupancy models provide a means to estimate these two probabilities and present results from these models that estimate eDNA sampling efficiency in terms of field effort, diagnostic

effort, and the optimal times of the year to detect the eDNA of chytrid fungus and ranaviruses. While these pathogens differ in the times of year they are most likely to be detected, our results suggest both pathogens could be detected with 95% confidence with as few as 5 water samples per habitat and tested with 3 PCR reactions per sample

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Title: Exploring Genetic Connectivity of Stream Salamander Populations Within Stream Systems in the New York City Metropolitan Area

Graduate Student Author(s): Nicole Fusco*, Department of Biological Sciences (Ecology), Fordham University, 31 Whippoorwill Rd. Armonk, NY 10504; nfusco1@fordham.edu; Ellen Pehek, New York City Department of Parks and Recreation, 1234 Fifth Ave, Rm 237, New York, NY 10029; Ellen.Pehek@parks.nyc.gov; Jason Munshi-South, Department of Biological Sciences (Ecology), Fordham University, 31 Whippoorwill Rd. Armonk, NY 10504; jmunshisouth@fordham.edu.

Abstract: The Northern two-lined salamander (*Eurycea bislineata*) plays an important ecological role in Northeastern forests yet they are incredibly susceptible to human disturbances due to a reliance on both terrestrial and aquatic habitats for survival, dispersal, and reproduction. To understand if urbanization in and around New York City, is affecting Northern two-lined salamander (*Eurycea bislineata*) populations, we investigated population structure and genetic connectivity between streams within urban, suburban, and rural stream habitats. Despite differing levels of urbanization within each habitat, results show greatly reduced genetic connectivity between streams within the urban habitat compared to the suburban and rural sites. Yet in the urban and suburban habitats, streams located within connected green spaces showed higher levels of gene flow between neighboring streams, than did areas separated by greater amounts of anthropogenic disturbance. We tested for, and found that isolation-by-distance governing the spatial patterns of populations within these habitats, yet other natural (watersheds) or anthropogenic variables (roadways) may be causing barriers to gene flow. These results demonstrate that urbanization affects gene flow between streams in highly urbanized stream networks in NYC, yet connected green spaces may be able to preserve gene flow between very nearby stream sites. Overall, we need to maintain connectivity within and between branches of stream systems to sustain healthy salamander populations so that these populations may subsist within our urban freshwater aquatic ecosystems.

Title: A Roadway Wildlife Passage System Constructed and Monitored for Bog Turtles (*Glyptemys muhlenbergii*) in New Jersey

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Abstract: Terrestrial wildlife in suburban landscapes regularly encounter barriers to movement (such as local two-lane roads) within their home range. Vehicles traveling along the roadway can kill or injure species attempting to traverse the obstacle. Designing and constructing wildlife passage systems to facilitate safe movement of animals across barriers is an important conservation topic. The New Jersey Division of Fish & Wildlife (NJDF&W) launched a project called Connecting Habitat Across New Jersey (CHANJ) that provides tools and resources to facilitate reconnecting fragmented natural areas. Guided by CHANJ products, we constructed a passage system designed for bog turtles (*Glyptemys muhlenbergii*) and monitored the local turtle populations and road transect before, during, and after construction. The passage system is along a road in Monmouth County. Two under-road tunnels were installed in March 2018 and associated funnel fencing was installed by April 2019. The tunnels are concrete trench drains with grate tops. The Animex-brand funnel fencing spans 165 meters on each side of the road, adjoining the tunnel entrances and an existing bridge that spans a small tributary. Monitoring is ongoing to evaluate two primary project goals: 1) To reduce the number of roadkill animals along the road transect and 2) To provide a safe

passage opportunity for wildlife to move from one side of the road to the other. Monitoring will be performed from April 2017 to October 2020 and includes opportunistic visual surveys for turtles, radio-telemetry of up to 20 bog turtles, spotted turtles (*Clemmys guttata*), and woodland box turtles (*Terrapene carolina carolina*), roadkill transect surveys at the study site and a control transect, and active infrared camera monitoring of the tunnels using Hobbs Active Light Trigger (HALT) packages. We are presenting now on three seasons of population monitoring, radio-telemetry, and roadkill surveys, along with one season of camera data. We believe this is the first wildlife passage system designed for bog turtles across the range that will be assessed for effectiveness and evaluated as a mitigation action to reduce the number of bog turtles killed by vehicles and increase the permeability of fragmented landscapes.

Title: Quantifying Road Mortality in Preparation of an Amphibian Passage System Installation

Author(s): Allegra Mitchell*, Conserve Wildlife Foundation of New Jersey, 501 East State Street, Trenton, NJ 08609; allegra.mitchell@conservewildlifenj.org; MacKenzie Hall, NJ Division of Fish and Wildlife, Endangered and Nongame Species Program, 1255 County Rd 629, Lebanon, NJ 08833; Mackenzie.Hall@dep.nj.gov

Abstract: Habitat connectivity is crucial for species persistence within a highly urbanized landscape such as New Jersey. Land preservation, habitat restoration, and mitigation of wildlife movement barriers are some strategies that the state is pursuing to make our landscape and roadways more permeable for terrestrial animals. At Waterloo Road in Sussex County, one of the largest cross-road amphibian migrations in New Jersey takes place each spring, when thousands of individuals attempt to cross the high-traffic county road as they move from the forest where they spend most of their lives to the vernal pool where they breed. Despite the land itself being preserved for its unique natural and historic values, the roadway causes high amphibian mortality rates, which is especially concerning for declining species such as the spotted salamander (*Ambystoma maculatum*) and the Jefferson salamander (*Ambystoma jeffersonianum*), a New Jersey Species of Special Concern. Luckily, a wildlife crossing system is planned specifically to address amphibian mortality along Waterloo Road. An intensive road mortality monitoring survey effort has been underway for three years that will be used to assess the effectiveness of this mitigation system and to provide an example for future projects of its kind. With pre- installation monitoring complete, we summarize the extent of vehicle-caused mortality on Waterloo Road, and prepare for the construction of the wildlife crossing system.

Title: Dietary Niche Overlap and Potential Partitioning Between the Endangered Spotted Turtle (*Clemmys guttata*) and Other Turtle Species

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Abstract: Interspecific interactions are factors that influence habitat selection and use in most organisms. Turtle species – like many other organisms – in similar habitats can potentially compete for resources such as habitat and food. My study explores the extent to which such factors influence habitat usage in the endangered spotted turtle (*Clemmys guttata*). Specifically, I investigated interspecific interactions in two ways. I first compared the use of water bodies by *C. guttata* with that of other turtle species. This comparison, supplemented with stable isotope analysis, was capable of providing comparatively stronger indications of potential resource competition than could be extrapolated from solely habitat usage. I then used this analysis to investigate potential overlaps in feeding ecology (and thus potential competition for food). Specifically, I collected samples

of turtle claw keratin, which were then analyzed to determine if similar $d^{13}C$ and $d^{15}N$ isotopes were found among different turtle species. Such similarities among different species were used as proxies to indicate comparable diets and trophic levels, respectively. These complimentary methods allowed us to effectively determine whether the turtle species were potentially competing for a) habitat resources (based on cohabitation and pond use overlap) and b) food resources (by comparing stable isotope profiles). The results of our study could be of use to conservation agencies because potential overlaps in diet – and consequent resource competition – can provide an indication as to which specific aquatic and terrestrial regions need to be the focus of future conservation strategies for *C. guttata*.

Title: Habitat Parameters and Pond Occupancy of the Eastern Tiger Salamander (*Ambystoma tigrinum*) in Maryland and Delaware

Graduate Student Author(s): Hannah G. Small*, Department of Biological Sciences, Salisbury University, Salisbury, MD 21801; hgsmall@salisbury.edu; Arthur J. Lembo, Department of Geography and Geosciences, Salisbury University, Salisbury, MD 21801; ajlembo@salisbury.edu; Eric B. Liebgold, Department of Biological Sciences, Salisbury University, Salisbury, MD 21801; ebliebgold@salisbury.edu

Abstract: Habitat loss and fragmentation are two important drivers of population declines seen in amphibians around the world. Due to their biphasic life-style, amphibians are susceptible to threats both in their aquatic and terrestrial habitats. The Eastern Tiger Salamander (*Ambystoma tigrinum*) is endangered throughout much of its range in the eastern United States, including Maryland and Delaware. *A. tigrinum* breed in ephemeral freshwater ponds and then migrate into the surrounding terrestrial environment after metamorphosis where they are primarily fossorial. Little is known about what local and landscape habitat characteristics play a role in breeding pond use. We sought to understand what habitat variables at the local and landscape levels for ponds most likely influence pond occupancy. We measured pond occupancy and water quality parameters at ponds with and without *A. tigrinum* breeding during the 2018 and 2019 breeding seasons. We used geographic information systems (GIS) data to determine pond area and landscape composition surrounding the pond at different scales. We found that pond occupancy was not significantly associated with any local or landscape habitat characteristics we measured, suggesting minimal or no preference in breeding pond use by *A. tigrinum* in Maryland and Delaware. These findings provide insight on habitat use in a varying landscape and can be used in management decisions to better conserve and protect this endangered species and other pond breeding amphibians.

POSTER PRESENTATION ABSTRACTS

(alphabetical by first author last name)

Title: Assessment of Amphibian & Reptile Communities at Created Wetland Mitigation Sites in New Jersey

Author(s): David K. Brotherton, Amy S. Greene Environmental Consultants, Inc., 4 Walter E. Foran Boulevard, Flemington, NJ, 08822; dbrotherton@amygreene.com

Abstract: The loss and degradation of wetland habitats is a leading cause for the decline of amphibian and reptile populations worldwide. The federal Clean Water Act and New Jersey Freshwater Wetland Protection Act and Coastal Zone Management Rules require compensation for unavoidable wetland impacts. Compensation is accomplished through the creation or enhancement of wetland mitigation sites within the same watershed as the impacts. Amy S. Greene Environmental Consultants, Inc. has designed and created several mitigation sites throughout New Jersey to offset wetland impacts from development. Specific hydrologic conditions and vegetative communities created as a result of these projects provide suitable habitat for amphibians and reptiles. General inventories at four of these sites highlight the amphibian and reptile

communities colonizing these created wetland habitats. We monitored the occurrence of amphibians and reptiles for several years using amphibian call counts, vernal pond surveys, minnow trapping and incidental encounter surveys. Species encountered within created and/or reference wetlands included green frog (*Lithobates clamitans*), American bullfrog (*Lithobates catesbeianus*), pickerel frog (*Lithobates palustris*), Atlantic coast leopard frog (*Lithobates kauffeldi*), wood frog (*Lithobates sylvaticus*), Fowler's toad (*Anaxyrus fowleri*), spring peeper (*Pseudacris crucifer*), northern grey treefrog (*Hyla versicolor*), northern cricket frog (*Acris c. crepitans*), eastern painted turtle (*Chrysemys p. picta*), Eastern box turtle (*Terrapene c. carolina*), spotted turtle (*Clemmys guttata*) (NJ species of special concern), snapping turtle (*Chelydra serpentina*), red-bellied turtle (*Pseudemys rubriventris*), blue-spotted salamander (*Ambystoma laterale*) (NJ endangered), red-backed salamander (*Plethodon cinereus*), spotted salamander (*Ambystoma maculatum*), eastern red-spotted newt (*Notophthalmus viridescens*) and northern watersnake (*Nerodia sipedon*).

Title: Implementing a Citizen Science Project to Aid in Amphibian Migrations: A Success Story from the Finger Lakes (NY)

Undergrad Student Author(s): John A. Bateman, Department of Conservation and Horticulture, Finger Lakes Community College, Canandaigua, NY 14424; salamanders@flcc.edu; Aleah Buckalew*, Department of Conservation, Finger Lakes Community College, Canandaigua, NY 14424; hawkheart125@gmail.com; Mackenzie Lynk*, Department of Conservation, Finger Lakes Community College, Canandaigua, NY 14424; mlynk@fingerlakes.edu

Abstract: The Finger Lakes region in Upstate New York is host to a variety of amphibian species, which are, collectively, vital to both the terrestrial and wetland ecosystems. During early spring, amphibians emerge from the upland and make their way to ephemeral wetlands to complete their life cycle. Finger Lakes Community College's Muller Field Station is located adjacent to the Honeoye Lake inlet and is at the center of a large amphibian migration corridor. This pathway is bisected by a heavily-trafficked road, and vehicle-related mortality is common during spring. Historically, a small group of students have aided amphibians in their migration by physically moving them across the road, however, there was a high proportion of roadkill on big nights despite their efforts. This past spring, the opportunity to assist in moving amphibians was opened up to a broader audience via social media, resulting in more than four times the usual number of volunteers. A total of 3,872 migrating amphibians across ten different species were moved across the road, with less than a 5% mortality rate on worked nights. These numbers suggest amphibian casualties can be greatly lessened through public education and participation in conservation efforts. As this citizen science project continues to expand in regard to public participation, the attention towards the amphibian community will grow, ultimately benefitting these species.

Title: Wildlife Rehabilitator Data as an Additional Herpetological Health and Monitoring Information Source

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Abstract: Wildlife agencies have limited data available to assess the health of free ranging herpetofauna, and could bolster their informed decision making capabilities using the case data submitted by licensed wildlife rehabilitators. This requires standardized record keeping by rehabilitators, followed by systematic data analysis by the state agencies who regulate them. Cornell Wildlife Health Laboratory digitized wildlife rehabilitator case records (n=60,000 across all taxa) that had been submitted in paper format to the New York State Department of Environmental Conservation during calendar years 2012, 2013, and 2014. Data collected were species, reason for presentation, and corresponding disposition of each animal. In this three year period, New York wildlife rehabilitators handled 2,655 individual reptiles and amphibians, including ten state-

protected species: two endangered, *Glyptemys muhlenbergii* and *Kinosternon subrubrum* (n=4), two threatened, *Crotalus horridus* and *Emydoidea blandingii* (n=6), and six special concern, *Clemmys guttata, Glyptemys insculpta, Terrapene carolina, Apalone spinifera, Heterodon platirhinos*, and *Cryptobranchus alleganiensis* (n=1,154). Nine non-native species (n=60) were also received. The major causes of distress were trauma (52%) and orphaning (21%), with unknown (14%), habitat loss (8%), infectious (4%) and toxin (1%) playing a lesser role. Release rate for all causes of distress was 45%. Thorough, timely reporting by rehabilitators could aid in the monitoring efforts of state wildlife agencies by identifying new disease outbreaks that may otherwise go undetected. This information is also valuable for pinpointing new species occurrences outside of previously recognized range, locating road mortality hotspots, facilitating discussion about the impacts of rehabilitation activities, and prompting research collaborations.

Title: Influences of Prey Availability on Lifelong Patterns of Growth in a Squamate Reptile

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Abstract: In environments where conditions vary significantly from year to year, the rate of growth and maximum body size constitutes a link between resource acquisition and partitioning. Additionally, nutritional conditions experienced during development or early life can have pronounced influence on lifetime patterns of growth, and thereby, significant impacts on reproductive success and survival. We analyzed 20 years of mark-recapture data on two ecotypes of the Western Terrestrial Garter Snake (*Thamnophis elegans*) to characterize snake responses in growth rate and maximum body size to prey availability in the Lassen National Forest, California. Ecotypes of *T. elegans* differ in key life-history traits, wherein the fast-living lakeshore ecotype reproduce younger, have larger litters and experience lower survival than their slow-living mountain meadow counterparts. Using Bayesian von Bertalanffy growth models, we found slow-growing meadow snakes exhibit more sensitivity to prey availability than the faster growing lakeshore ecotype. These patterns suggest compensatory growth—accelerated growth following unfavorable conditions—and were most pronounced in the meadow ecotype. The lakeshore ecotype, because of its faster pace-of-life, is likely unable to achieve the same degree of compensatory growth because allocation of energy to reproduction is more constant. This study highlights how we can use spatial and temporal variability in the environment to predict population level responses in growth parameters of reptiles. Furthermore, our results indicate that slow growth and starvation endurance may improve an animals' ability to compensate for a poor start, which has important implications for individual and population level demographic processes in increasingly stochastic climactic conditions.

Title: Estimating Detection Probability of Larval Salamanders Using Multiple Methods

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Abstract: Many studies suffer from imperfect detection probability, i.e., species are not detected when individuals may be present. In occupancy studies, detection probability is often treated as a nuisance variable. When used as a primary variable of interest, detection probability can be examined as a function of sampling covariates with the goal of maximizing the probability of encountering target species. Efforts to determine which methods maximize detection probability will benefit monitoring programs, particularly for species that are difficult to detect. We used three sampling methods, leaf litter bag surveys (LLB), visual encounter surveys (VES) and flip and search methods (FS) to detect multiple salamander species, including *Euycea bislinata, Desmognathus fuscus, Desmognathus ochrophaeus*, and *Gyrinophilus porphyriticus*. We estimated occasion-specific estimates of detection and used an ANOVA to determine if detection probability varied among sampling methods. We found that the FS method yielded higher detection estimates for *G. porphyriticus*, and the LLBs yielded higher detection estimates for all other species. In addition, occupancy estimates derived from the best methods of detection for each species changed drastically when compared among other single-method models, suggesting that non-optimal sampling methods gave biased estimates of occupancy, related to a low probability of detecting species at occupied sites. Furthermore, single method sampling provided higher detection probability estimates as compared to estimates derived from models that combined all sampling methods. In conclusion, larval salamander species monitoring should rely on FS and LLB methods as a means of maximizing detection probability to reduce costs and increase effectiveness for research projects.

Title: Urbanization and Its Effects on the DeKay's Brown Snake (*Storeria dekayi*)

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Abstract: The process of urbanization has largely changed natural landscapes and threatened the survival of wildlife, which draws increasing attention to the conservation of biota in urban areas. Currently, most work assessing the effect of urbanization on wildlife has been predominately focused on birds and arthropods, with few studies conducted on other taxa, such as the reclusive and elusive reptiles. DeKay's brown snake, *Storeria dekayi*, is a small, fossorial snake species found throughout the Eastern and Central United States. They frequently inhabit urban areas and often form aggregations, which gives us a good opportunity to explore how reptiles respond to urban environments. We investigated several urban populations of *S. dekayi* found in Essex County and Middlesex County, New Jersey. We used a capture-recapture sampling method and identified recaptured individuals based on their unique markings to estimate the local population size. Initial results suggest that *S. dekayi* is an urban adaptor that can sustain exceptionally high population densities in urban environments.

Title: Factors Influencing Size in Unisexual Salamanders

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Abstract: Given that salamanders display indeterminate growth, longer salamanders are presumably older and/or better fed, and therefore have been more successful in their environment. Unisexual salamanders can reproduce by cloning, and we

hypothesize that some clonal lineages are capable of faster growth or more efficient use of resources. We analyzed data from a drift-fence survey of four vernal pools in Maine, in order to determine what factors contribute to unisexual salamander growth. Using Program R, we made a series of linear regression models to determine what combination of factors best explained variation in SVL. We hypothesized that better-adapted clones and those coming from better habitat would be longer, and that juveniles captured later in the season would also be longer. The only factor which was present in all top models was clonal lineage. The other important factors were pool and azimuth, which most likely indicates that the habitat quality was not uniform around the pools.

Title: Photo Identification of the Eastern Hellbender (*Cryptobranchus alleganiensis*) Using i3S Spot

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Abstract: The ability to identify individuals plays a key role in ecological and behavioral studies but often relies on invasive techniques that elicit stress. Less invasive methods may offer the opportunity to observe natural behaviors that could otherwise be affected by traditional marking techniques. Photo-based pattern recognition has recently emerged as an effective noninvasive method for the individual identification of some herpetofauna species by identifying individuals by their unique patterns and markings. We assessed the effectiveness and accuracy of I3S Spot identification software for individual identification of Eastern Hellbenders (*Cryptobranchus alleganiensis)* via their unique spotting patterns and examined the difference in results across different users. Preliminary results indicate that I3S Spot may be an effective means of identification for adults of this species but results may be impacted by user interpretation, photo quality, and the upkeep of databases. Further research is warranted to determine the applicability of this technique to larval and subadult individuals. Currently, there is no safe and reliable way of marking young individuals for field studies. The ability to identify individual hellbenders in this way offers potential new methods for studying the behavior of this sensitive salamander *in situ.*

Title: Carryover Effects of Salinization on Water Retention in Juvenile Wood Frogs (*Lithobates sylvaticus*)

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Abstract: Road salt, a deicing agent commonly used in northern latitudes, is of increasing environmental concern due to its adverse effects on amphibians living in roadside wetlands. A recent study reported male wood frogs (*Lithobates sylvaticus*) migrating to roadside ponds displaying higher water retention than male frogs migrating to woodland ponds. This is the first documented phenotypic effect of elevated salinity from road salt runoff on adult amphibians. However, the reason for the observed difference is unknown and could be a consequence of larval developmental conditions. To gain insight on how developmental conditions might affect water retention in metamorphosed wood frogs, we raised wood frog larvae under freshwater and saline treatments in 50-gallon mesocosms and will subsequently measured rates of water loss after metamorphosis. After ensuring individuals are fully hydrated and relieved of stomach contents, they will be individually housed in suspended wire mesh desiccation chambers. Each individual will be weighed every 20 minutes until 20% of its body mass is lost, ensuring that they are not exposed to lethal dehydration levels. Variations in mass loss will then be analyzed to compare water retention ability of individuals raised in freshwater and saline treatments, from which conclusions can be made about the effects of road salts on post-metamorphic survival.

Title: Genetic Spatial Structure of the Spotted Turtle, *Clemmys guttata*, an Endangered Species Facing Rising Sea Levels

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Abstract: In species of conservation concern with small populations, genetic connectivity can alleviate the negative effects of low genetic diversity, which can be associated with further population declines. The endangered Spotted Turtle (*Clemmys guttata*), typically persists and breeds in freshwater wetlands with low population numbers. However, they are semi-terrestrial turtles with the potential to disperse long distances. Understanding genetic connectivity and whether habitat loss and fragmentation limits connectivity is important to predict future population trends of this species. We used buccal swabs to collect tissue samples and analyzed 12 microsatellite DNA loci in 164 spotted turtles across five populations on the Atlantic Coastal Plain in Maryland and Delaware. We found that spotted turtles typically dispersed long distances between populations, as far as 18 km. However, as most populations were > 47 km apart, we found significant genetic differentiation (FST) between some populations. Notably a population found a coastal island was genetically differentiated from even proximate populations. We then used regressions to test which of three distance measures (linear distance, salt water avoidance distance, and weighted resistance distance) best explained FST between populations. We found that pathways between populations that included avoidance of saltwater best explained FST. We conclude that predicted sea level rise along this part of the Atlantic Coastal Plain will likely negatively affect spotted turtle populations in this area, not only directly via salinity intrusion of breeding habitats, but also indirectly by slashing genetic connectivity between populations.

Title: Wetland and Upland Habitat Restoration Project to Restore Connectivity Between Core Habitats on a New Jersey Wildlife Management Area

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Abstract: This project site, located in Pilesgrove, Salem County, NJ, is part of the Salem River Wildlife Management Area. The site includes two discrete wetlands separated by 22 acres of row crops, with the southern wetland bordered by an additional 8 acres of row crops. The northern wetland is a scrub-shrub and forested wetland mix with open areas of dense *Phragmites aulstralis*. The southern wetland is a mosaic of former agricultural wetlands and scrub-shrub wetlands. Prior to NJ Audubon surveys in 2013, the site's last known observation was in 2001. Initial surveys by NJ Audubon resulted in 1 new bog turtle occurrence. Between 2014-2019, radio telemetry and surveys resulted in 6 new individuals and 1 recaptured individual from 2001. Initial restoration plans included removing non-native invasive plants and connecting habitats by replacing 10 acres of row crops with native cover. In 2017, the plan grew to include the replacement of 30 acres of row crops. In 2018, a local farmer seeded 27 acres of native grasses and wildflowers in the agricultural fields and added native wetland plants to the remaining 3 acres, expanding wetland habitat. In March 2019, native shrubs were planted at a low density in 5 acres of seeded fields. Future plans include continued *Phragmites* removal, thinning woody vegetation, and restoring hydrology. These fields, modified for agricultural use, provide opportunities to restore hydrology by removing tile drains and plugging

ditches. Radio telemetry and survey efforts will continue to monitor restoration success and to determine core bog turtle habitats.

Title: Habitat Assessment for Blanding's Turtle (*Emydoidea blandingii*) in Western New York

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Abstract: The Blanding's Turtle (*Emydoidea blandingii*) is a threatened species of reptile in New York. The distribution of Blanding's Turtle populations in the western portion of the state is poorly understood. With only a small number of sightings, mostly centered on roadways, little is known about the species' habitat use and movement patterns in this region. We employed Maxent software to generate a species distribution model based on previous Blanding's Turtle locations throughout New York. This model will be used to assess the availability of suitable habitat and guide surveys to determine the presence or absence of populations. The results of these assessments will help to guide habitat management and other conservation efforts for this species in Western New York.

Title: Range-wide Impacts of Variation in Metabolic Rate and Thermal Plasticity Under Current and Future Climates for the Salamander, *Plethodon cinereus*.

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Abstract: Predicted increases in global temperature are expected to increase extinction risk for ectotherms, primarily through increased metabolic rates. Higher metabolic rates generate increased maintenance energy costs which are a major component of energy budgets. Organisms often employ plastic or evolutionary (e.g. local adaptation) mechanisms to optimize metabolic rate with respect to their environment, but predictions commonly assume species' population responses are invariable. Using a widespread salamander species as an amphibian model, we show that variation in populations, and their plasticity, alter predictions of energy expenditure under current and future climates. Based on over 1700 metabolic trials on 140 individuals, salamanders from populations in warmer climates lowered metabolic rate when exposed to summer

temperatures, leading to immense energy savings. No plasticity was evident in populations from cooler climates. Energy savings for warm-climate populations resulted in similar maintenance energy costs across the range, meaning plasticity in metabolic rate allows populations to persist in warm parts of the range. No population showed plastic metabolic rate responses to future climate scenarios. Limits to plasticity observed in this study show that maintenance costs will be higher than any population currently experiences despite plasticity's adaptive advantage under current climates. Consequently, impacts of warming will be rangewide instead of focused at the warming edge, and warming will likely impact key demographic rates, such as growth and reproduction, into the future.

Title: Preliminary Results of a Long-term Freshwater Turtle Population Study in New Jersey

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Abstract: With over half of the known turtle populations in decline, it is imperative that researchers establish long-term population monitoring study sites. In 2018 a long-term aquatic turtle population study transect was established along the South Branch of the Raritan River, in Hunterdon County, New Jersey. The sampling consisted of snorkeling to hand capture all turtles during surveys in July, August, and September. The preliminary results of the first year of the study identified five species and 81 captures. The species collected were the common map turtle (*Graptemys geographica),* eastern painted turtle *(Chrysemys picta picta),* common musk turtle *(Sternotherus odoratus),* common snapping turtle *(Chelydra serpentine),* and northern red bellied cooter *(Pseudemys rubriventris).* Going forward the sampling will focus on *G. geographica*, the most frequency captured species in the sample site. Surveys will be conducted during additional times of year, utilize additional survey techniques, and additional survey transects will be established. Hopefully, the data collected from this study will help determine population health, assess ecosystem health, identify potential threats, and help mitigate these threats.

Title: Spotted Turtles on the Delmarva Peninsula: Population Dynamics and Conservation Implications

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Abstract: Given the ubiquity of anthropogenic impacts, we need to understand the current population demographics of freshwater herpetofauna using unbiased estimates of population size. While southern and northern populations of the spotted turtle, *Clemmys guttata*, are relatively well studied, little is known about the demographics and habitat characteristics that affect populations of *C. guttata* on the Atlantic Coastal Plain. Our goals were: 1) to use mark-recapture methodology to estimate population size and sex-specific survival of four populations on the Delmarva Peninsula and 2) to

determine what pond characteristics affected total numbers of *C. guttata* and the proportion of females at each pond. Based on 2016-2017 mark-recapture surveys at four sites, our estimated population sizes were small (<70 for three of our sites) despite high estimated survival rates for both sexes. We were more likely to find *C. guttata* in bodies of water with low salinity < 1 ppt (83.33%) than in water with salinity ≥ 1 ppt. Sites with more extensive freshwater marsh habitats had greater levels of temporary emigration in and out of ponds. Our results highlight the potential negative impacts of saltwater intrusion due to rising sea levels rise and low dissolved oxygen on these populations, especially given our baseline population estimates of *C. guttata* on the Atlantic Coastal Plain.

Title: Populations on the Edge: Morphometric Variation in Northern Populations of Bog Turtles (*Glyptemys muhlenbergii*)

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Abstract: In northern latitudes the "growing season" is compressed due to climatic conditions. This truncated activity season may affect growth, adult size, and reproductive output of poikilothermic ectotherms. The Lake Plains region of Central New York is home to the northern most populations of Bog Turtles *(Glyptemys muhlenbergii*). We compare morphometric and population data from two of the Lake Plains populations: Site M (2017 $\widehat{N}$=160±22SE) and Site J (2015 $\widehat{N}$=18±5SE). The 2017 age distribution at Site M, based on estimations from annuli, was 0-5: 3%, 6-10: 31%, 11-15: 44%, 16-20: 13%, and >20: 8%. Site M's 2017 adult (>10 annuli) sex ratio was 31M:26F and 62M:72F when incorporating captures since 1997. Site J's 2015 adult sex ratio was 2M:9F and 16M:24F when incorporating captures since 1987. Average straight line carapace length for both populations combined was larger in males (84.0 mm) than females (77.8 mm). . When comparing these metrics to other parts of the range, morphometrics are consistently smaller, growth slower, and sexual dimorphism more pronounced in Lake Plains bog turtles than any other populations of the species. This has conservation implications since female turtle body size is known to be related to the number of eggs females can carry.

Title: Outcomes from Experimental Ranavirus Epidemics in Wood Frog Tadpoles.

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Abstract: Ranaviruses are emerging viruses of amphibians that are known to cause mass die-offs and population declines around the globe, however, epidemics appear to be sporadic and inconsistent across amphibian populations. We use a Ranavirus-wood frog (*Lithobates sylvaticus*) model to better understand how environmental stressors affect epidemic outcomes. Sixty wood-frog larvae were introduced into each of 110 mesocosms with the following treatments mimicking environmental stressors: low conductivity (< 1000 mS/cm) at ambient temperature, low conductivity (<1000 mS/cm) at elevated temperature (3°C above ambient), high conductivity (1900mS/cm) at ambient temperature, high conductivity (1900mS/cm) at elevated temperature (3°C above ambient). Ranavirus was introduced into treatment tanks (N = 89tanks) by releasing one virus inoculated tadpole, with control tanks (N = 21 tanks) receiving one mock-inoculated individual, when average Gosner stage in each tank ranged from 27 through 36. Tanks were checked daily to record mortalities and to remove surviving metamorphs. Epidemics occurred in 79 of the 89 tanks. In elevated temperature tanks, epidemics consisted of approximately 50% of tadpoles dying and 50% reaching Gosner 41. In ambient temperature tanks, epidemics consisted of 87% of tadpoles dying and 13% reaching Gosner 41. Virual loads on surviving froglets will be determined later this summer.

Title: Amphibian Habitat Conservation Through Wetland Mitigation Banking

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Abstract: The Evergreen Rio Grande Swamp Mitigation Bank is a compensatory wetland mitigation bank that was designed to benefit the state-endangered eastern tiger salamander (*Ambystoma t. tigrinum*) and Cope's gray treefrog (*Hyla chrysoscelis*).

Baseline surveys were performed prior to construction to sample and census the amphibian and reptile community present at the Bank site. The Bank design incorporates bulk debris removal; ATV-deterrence; invasive species control; vernal pool creation, enhancement and preservation; emergent, scrub/shrub, and forested wetland creation; and forested upland enhancement and preservation. State and Federal approvals were obtained to construct the Bank. During Bank construction, herpetological monitoring was performed to salvage herpetofauna and provide for any wildlife incident response. Six (6) species of herptiles including 14 individuals were safely collected and relocated away from the construction zone, including

eastern tiger salamander and the state special concern marbled salamander (*Ambystoma opacum*). The results of herpetological monitoring demonstrate that having a herpetologist present during construction in herp-sensitive locations proves valuable in eliminating or reducing incidental harm to amphibians and reptiles from construction work. The Bank's hydrology, vegetation and herpetofaunal community will continue to be monitored in future years to determine the positive, negative, or null effects of the Bank project on amphibian habitat. Wetland mitigation banking and permittee-responsible wetland mitigation may be land-use mechanisms that provide an opportunity to practice and promote amphibian habitat conservation throughout New Jersey.

Title: Effect of Salinity Conditions During Development on Choice of Soil in Juvenile Wood Frogs (*Lithobates sylvaticus*)

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Abstract: Anthropogenic salinization is a pervasive pollutant in much of the northeastern United States, due to the widespread use of chemical deicing agents. While studies have examined the physiological effects of salinization on amphibians across life stages, behavioral responses to increased salts within habitats are less studied, particularly in juveniles. In this study, we experimentally test whether juvenile wood frogs (*Lithobates sylvaticus*) can detect and avoid salt in terrestrial soils. Furthermore, we test whether the salinity levels experienced as aquatic larvae affect choice of salinity levels in soil chosen by juveniles. We raised larvae in 50-gallon mesocosm tanks under low salinity (average value) and high salinity (average value) until Gosner stage 42. We are conducting behavioral choice trials. Metamorphs are placed individually in 10-gallon aquariums containing sand treated with low salinity or high salinity water separated by a soil-level divider. Time-lapse cameras monitor the frogs' movements for a period of four hours and we record the soil the frog is sitting on at 5-minute intervals. We will calculate percent time spent on each treatment to determine if there is a significant difference in soil choice between frogs raised in low versus elevated salinity levels. When considering the choice of soil, the presence of salinity-driven avoidance behaviors may potentially lead to a shift in the allocation of viable habitat in wood frogs and other amphibian species.

Title: Impacts of Roads on Diamondback Terrapins in Southern New Jersey

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Abstract: Road mortalities caused by collision of vehicles with Diamondback Terrapins (*Malaclemys terrapin*) pose a serious threat to nesting females emerging from the marsh. Researchers at The Wetlands Institute have been collecting road mortality data since 1997 over the course of a 38-mile transect that begins in Stone Harbor, New Jersey and reaches Ocean City, New Jersey. The study is focused on surveying major coastal causeways that run through marsh habitat and documenting live and dead terrapin encounters. Road mortality data is collected during road patrols that are performed twice daily at 8am and 11am. During the past two years (2017-2018) additional surveys have been conducted on Stone Harbor Boulevard at 9am, 2pm and 4pm. Over the past five years (2014-2018) 4,632 terrapins have been encountered on the roads, 2,574 of those encounters have been fatal and 2,058 encounters have been live terrapins which were moved to safety. The collected data is analyzed to determine the relationship between terrapin activity and potential explanatory spatial, temporal and human factors. Continued study of terrapin nesting activity on local roadways is important for determining peak activity times and factors that trigger terrapin nesting to improve conservation efforts and road mitigation strategies.