Oral Presentations

(Abstracts ordered as on agenda.)

Year of the Turtle: Development of a New Conservation Paradigm

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The designation of 2011 as 'Year of the Turtle' by Partners in Amphibian and Reptile Conservation and their turtle conservation partners emerged as a novel paradigm for conservation and raising awareness in North America, with tendrils beginning to extend around the globe. Momentum of the campaign is increasing as the year progresses, drawing together dozens of partners including government agencies, conservation organizations, research scientists and citizen scientists, veterinarians, the pet industry, trade organizations, and the public. The heart of the program is the empowerment of individuals and independent groups to work within the scope of their own influence to facilitate additional focus and activities on turtle conservation, research, and education. With almost 50% of world freshwater turtles and tortoises threatened with extinction, the attention is past due. However, prognosis for many conservation success stories is optimistic with this taxon, especially in North America, where the overall threat rate is lower. In addition, cultural values for retaining our turtle natural heritage are great, and appreciation for turtles among the public is high. Highlights of the Year of the Turtle can be found at www.yearoftheturtle.org and include monthly newsletters, photo contest and associated monthly calendar, USA turtle mapping project, State of the Turtle report, and more.

Shenandoah Salamander Occupancy Study Tests Historic Distribution Claims

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The endangered Shenandoah salamander (*Plethodon shenandoah*) resides on three isolated mountaintops in Shenandoah National Park. Distribution is thought to exist on north-facing talus slopes above 3,000 feet in elevation. Previous research claimed this salamander exists within dry talus habitats because it has been outcompeted from more suitable habitat by the more aggressive

red-backed salamander (*Plethodon cinereus*). Occupancy data collected in 2008 and 2009 across the range tests these expectations of limited distribution of the Shenandoah salamander. These occupancy data, coupled with macro and micro habitat data, allow us to test multiple hypotheses relating to habitat preference, use and the effect of competition as a limiting factor for the limited distribution of the Shenandoah salamander. This presentation will provide some of the results of a study first introduced at NE PARC in 2008. Results from this study are now being used to evaluate management options to reduce extinction risk for this salamander, given expectations of future climate change, which will be explicitly linked to a monitoring plan for the Shenandoah salamander.

Detecting Long-term Population Trends for the Eastern Box Turtle (*Terrapene c. carolina*) in Massachusetts

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The probability of patch occupancy has been suggested as a potential state variable for long-term, large-scale monitoring programs even when the probability of detection is <1 and abundance varies between sites. These models are particularly useful for rare or elusive species that are difficult to detect, as is the case with many rare reptiles. We designed an occupancy-based monitoring program for the eastern box turtle in Massachusetts, where they are a Species of Special Concern. Conservation Areas were designated in a statewide conservation plan for the species. Sixty sampling plots, four ha in size, were identified for sampling within these box turtle conservation areas. Plots were placed within early successional habitat and along forest edge habitat, locations where turtles gather to nest, so that sampling can occur during the nesting season. Sampling plots were stratified by region within the state and plans are to randomly sample these plots once every two years to track population trends. In addition, sites will be sampled three times within a single season once every five years to estimate the probability of detection. Model assessment using these preliminary data suggests several occupancy models are equally good at estimating occupancy, including the Royle/Nichols model. At our sampling sites, this model predicted a probability of box turtle occupancy of 0.82 and a probability of detection of 0.35. A power analysis indicates that we will be able to detect a -5% yearly population trend in approximately 18 years and a -3% trend in 25 years.

Spatial Ecology of Northern Map Turtles (*Graptemys geographica*) in an Altered River System: Implications for State Endangered Species Management and Mitigation

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Riverine turtle species are declining worldwide and many populations have been extirpated due to anthropogenic stressors. Last officially recorded in Maryland in the early-1990's, the Northern Map Turtle (*Graptemys geographica*) is listed as state endangered and is currently only known from the lower Susquehanna River in northern Maryland with a few records from nearby waterways (Elk and Bush Rivers). The Susquehanna River is divided by a hydroelectric dam, is heavily used for recreational activities, and has increasing shoreline development, all of which may negatively impact this population. Given the absence of basic ecological data of map turtles in Maryland, we used visual encounter surveys, trapping, and radio-telemetry to examine the habitat utilization of this population and further our understanding of these impacts. Our data suggest that impacts of dam operations on river water levels are dramatic and that high flows from the dam hinder basking activity and movements of turtles. Basking sites are submerged during high flows, drastically reducing the availability of suitable basking habitat. Dam activities have also hindered the natural deposition of sand, impacting the number of available nesting beaches. The remaining beaches are heavily inundated with human activity and force map turtles to nest in sub-optimal conditions (e.g. heavy canopy cover). We suggest the turtle's reaction to sudden changes in river flow and depth and the management of public lands for optimal nesting conditions is crucial in mitigating impacts on this population.

First Probabilistic Survey of Stream Salamanders in Maryland

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In 2007, the Maryland Biological Stream Survey (MBSS) added quantitative sampling of stream salamanders to their probability-based survey of biota, physical habitat, water chemistry, and riparian features in the 9,000 miles of wadeable, perennial streams in Maryland. The sampling method was developed to support (1) estimates of salamander distribution and abundance and (2) calculation of a stream salamander index of biotic integrity (SS-IBI), while minimizing sampling effort. Qualitative sampling of reptiles and amphibians within the stream corridor has been conducted since the initiation of the MBSS in 1995. The qualitative sampling provided dramatic evidence of the loss of stream salamanders in the urban area between Washington, DC, and Baltimore, MD, since the 1960s. The quantitative sampling provides the first estimates of stream salamanders statewide and by major watersheds. It also provides a mechanism for identifying the stressors affecting salamanders and headwaters streams in general. Preliminary results are provided. Attempts to validate the SS-IBI were unsuccessful as the MBSS method (modified from the SS-IBI developmental method for efficiency) did not capture as many individuals. Therefore, modifications to the method or the index are planned so that validation of the SS-IBI can be completed for use in the next round of the MBSS. Factors affecting this validation included (1) a greater range of stream types and sizes assessed, (2) sampling of random stream banks versus banks with best available habitat, and (3) assigning condition class thresholds to reference sites sampled with a different method.

Experimental tests of tunnel and barrier options for reducing road mortalities of freshwater turtles

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Roadways have become a pervasive feature of the landscape and can be a significant source of mortality for turtles. Increasingly, under-road passages are being employed to allow a range of wildlife species to move safely between habitat patches that are bisected by roadways. In an ongoing study, we examined the relative effectiveness of experimental passages and barriers for freshwater turtles. At outdoor laboratories, we examined the movements of painted turtles (*Chrysemys picta*) in response to varying light levels, tunnel size, tunnel entrance design, and barrier opacity. A total of 778 turtles (813 trials) were used in a factorial experimental design to test for effects of (1) tunnel lighting and size, (2) artificial lighting, and (3) guidance structure characteristics. Behaviors of turtles were quantified both as binomial responses (success/fail), and continuous responses (total time for the turtle to complete the trial, total number of hesitations in entering the tunnel, as well as rate and distance of travel). As the amount of natural light transmitted through the tops of tunnels increased, successful completion of the trials increased, and median time to complete the trial decreased. This relationship was also maintained when the lighting was artificial. Guidance structure characteristics did not affect the willingness of turtles to enter passages. Turtles moved at a slower rate when traveling along a translucent barrier, compared to an opaque one. Our results indicate the importance of designing road passage structures for freshwater turtles that provide adequate tunnel lighting in combination with opaque barriers.

Using Headstarting as a Tool for Both Herpetological Conservation and for Effective and Engaging Education

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To date, we have collaborated with more than 10 Massachusetts schools in headstarting two rare species, the Blanding's turtle (*Emydoidea blandingii*) and the eastern spadefoot toad (*Scaphiopus holbrooki*). Both efforts are part of long-term field conservation projects. In the case of the Blanding's turtle, headstarting is used as a means of overcoming decades of low recruitment levels in the third largest known population of the species in New England, the Great Meadows Blanding's turtle population. In the case of spadefoot toads, headstarted toadlets will be used in a reintroduction project that will begin in the spring of 2011. We have built simple curriculum projects around these headstarting programs that introduce students and their teachers to various

aspects of reptile and amphibian biology, conservation, and captive husbandry. To date, these headstarting programs have been conducted with great success in classrooms from first through twelfth grade. We radiotrack juvenile Blanding's turtles that have been raised in classrooms after their release back into their natal habitats and survivorship levels to date have been high. Similar post-release monitoring is planned with spadefoot toads using drift fence – pitfall trap systems. Student and teacher reaction has been very positive. Most importantly, we emphasize that these programs afford students a way to learn about and to actually be involved in helping solve local conservation problems, a very different message than the sense of hopelessness that is often conveyed to students in lessons about many environmental problems.

Terrapin Connection – Engaging Students with Environmental Education that Leads to Stewardship

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Diamondback terrapins possess the appearance and appeal to captivate the attention of individuals of all ages. Because of their charismatic nature they are an excellent motivator to introduce and teach environmental ethos and stewardship, as well as engage students in authentic, relevant research. In Anne Arundel County, Maryland Public Schools, we use the Northern diamondback terrapin *Malaclemys terrapin terrapin* as part of a research partnership to introduce and teach environmental impacts, responsibility, and basic scientific principles. Teachers in 75 classrooms at 59 schools use their terrapins in an interdisciplinary approach to explore topics such as habitat quality, water quality, and habitat restoration. Project turtles originate from natural nests at Poplar Island Environmental Restoration Site, and are part of a long-term research project in partnership with Dr. Willem Roosenburg of Ohio University. Throughout the nine-month project, students collect weekly growth data and raise them to a size that they can be sexed and Implanted with PIT tags. Approximately two weeks after the tagging procedure students travel to Poplar Island to release their terrapins and learn about restoration efforts at the 1,140 acre man-made island. This experiential learning approach reinforces the tools of science and the need for scientifically –based approaches to environmental stewardship.

Smartphone Technology and Herpetological Field Work: Results of a Youth Education Pilot Program

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Herpetological education programs are facing increasing challenges as students become ever more fixated on the newest wave of technological advances rather than the world surrounding them. During the summer of 2010 the Wildlife Conservation Society's Bronx Zoo Education Department piloted a program designed to synergize urban herpetological field work, smartphone technology, and education based social networking as part of a larger youth citizen

science project, in collaboration with the American Museum of Natural History, Parson's School of Design, Global Kids Inc., and the Macarthur Foundation. Over the course of several weeks, students ages 13-17 performed herpetological population surveys at specific sites within the Bronx Zoo grounds. Rather than use pen and paper to record data students were given use of Android smartphones and a newly developed application to record their site evaluations, relevant observations, population data, and field photographs. Each bit of data recorded by students was automatically uploaded to their personal profiles on a private education based social networking site (iremixworld.com) where students were able to share results, ask questions, create inferences, and blog about their experiences in the field with other students in similar citizen science programs in the New York City area. By discussing the format, results, and challenges of the pilot program, this talk hopes to stimulate a discussion on the issues facing herpetological education programs in a rapidly advancing technological world.

The Orianne Society's Appalachian Timber Rattlesnake Conservation Project

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Venomous reptiles are one of the most misunderstood and heavily persecuted groups of animals in the world. The majority of rare venomous snakes are vipers which are distributed across all continents with the exception of Australia and Antarctica. Twelve percent of vipers (32 species) are listed by the International Union for Conservation of Nature (IUCN) red list as Vulnerable, Endangered, or Critically Endangered. Timber Rattlesnakes are extinct in Maine and Rhode Island, listed as endangered in Connecticut, Massachusetts, New Hampshire, and Vermont, and listed as threatened in New York. The Orianne Society and the IUCN Viper Specialist Group, in partnership with local agencies and organizations, are working towards preventing further declines of Timber Rattlesnakes and promoting their recovery throughout the Appalachian Mountain Region. We are focusing our initial actions in three regions; the Lower Champlain Valley of New York and Vermont, southern New Hampshire, and the southern Blue Ridge region of Georgia and North Carolina. Specific components of the project include: 1) Protecting Key Habitats, 2) Education and Outreach, 3) Inventory and Monitoring, 4) Research and 4) Population Restoration. We envision a future where the people of the Appalachian region live side by side and appreciate Timber Rattlesnake as icons of the forest that are critical to their cultural heritage.

Consideration of Demographic and Spatial Variation among Regional Aggregations of the Wood Turtle (*Glyptemys insculpta*) Better Informs Management Strategies

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Turtles are now considered to be one of the groups most threatened by extinction on the planet. Protected areas (PAs) world-wide will become even more critical in the conservation of these species; however, some PAs are mixed-use landscapes where natural resources may be harvested

and land and waterways used to support recreational activities. Resource managers will become increasingly tasked with balancing human interests with their conservation objectives for turtles. Populations of the North American Wood Turtle (*Glyptemys insculpta*) have been in steady decline throughout its range primarily due to habitat loss. One of this species last remaining strongholds is the Delaware Water Gap National Recreation Area (DEWA), a mixed-use recreational facility located in the northeast. We used radio-telemetry and mark-recapture techniques to investigate the demographic and spatial attributes of *G. insculpta* at DEWA in order to assist with the development of an effective management strategy for this species. During this study we made greater than 1,300 captures, marked over 400 adults and juveniles, and radio-tracked 30 individuals from three different watersheds that were separated by between 12 and 43 km. Population size and density, body lengths and mass, and home range estimates were significantly different among locations. Our data demonstrate that the demographic and spatial attributes of *G. insculpta* can vary considerably among regional aggregations of this species. Understanding this variation is critical for the development of effective management strategies for *G. insculpta* at DEWA, which includes various actions for habitat conservation, threat mitigation, and continued law enforcement presence at these watersheds.

Reproductive Ecology, Demography, and Causes of Mortality in a Population of Eastern Musk Turtle (*Sternotherus odoratus*) in Central Massachusetts

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I conducted a field study on a population of eastern musk turtles in 2007 and 2008, representing the first formal research project on the general ecology of this species in New England. Radiotelemetry, mark-recapture, and nest monitoring methods were used to document adult movements, population demographics, female reproductive behavior, and nesting parameters within a lake and adjacent stretch of river in Palmer, Massachusetts. This study provides the first evidence that musk turtles lay more than one clutch per year in the northern portion of its range. At least 75% of radio-tagged females laid two clutches with inter-nesting intervals ranging from 17 to 25 days. Significantly smaller adult body sizes observed in lake turtles and considerably higher densities in the lake than river (186 and 9 adults/ha, resp.) suggest that aquatic habitat type may strongly influence population demographics in this species. Observed rates of nest predation (63-94%) and adult mortality (26%) were high, with adult mortality rates exceeding those reported from any previous radiotelemetry study of the species. The observed causes of adult mortality including predation, automobiles, human recreation, and a possible disease agent that has been investigated, but not identified. Nine percent of radio-tagged individuals exhibited symptoms of illness, 4% died following symptoms, and 13% were found dead without any obvious injuries. This study serves as a starting point for further ecological research in New England and for more complete regional comparisons of life history traits for this species.

Keynote

Panama Amphibian Rescue: An Integrated Conservation Strategy to Mitigate the Effects of Chytridiomycosis Sweeping Through Latin America

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Eastern Panama is the last remaining mountainous area of the Neotropics unaffected by chytridiomycosis. Biologists have been calling for a last-ditch attempt to save the amphibian biodiversity of this region for many years, but they have been frustrated by the lack of capacity to respond to such a compelling conservation problem. The Panama Amphibian Rescue and Conservation Project www.amphibianrescue.org was formed to build local Panamanian capacity to respond to the amphibian decline crisis and to focus the efforts and resources of a diverse group of partners to create ex-situ assurance colonies of some of the most imperiled amphibians. Academic partners are collaborating to develop a method to mitigate the effects of Bd in a wild situation with the ultimate goal of reintroducing extinct populations of amphibians from assurance colonies. In the past year we have established 1,200 square feet of new ex-situ facilities and established adequate founder populations of 3 of the most highly threatened amphibian species from eastern Panama. We have worked with partners, including the Panamanian Government to develop a National Strategic Plan to mitigate amphibian extinctions in Panama and have an extensive education and outreach plan. We have also conducted initial probiotics trials to test whether *Janthinobacterium lividium* can mitigate the effects of chytridiomycosis on Panama's iconic Golden Frog. We found that *J. lividium* did not persist for long enough on *Atelopus* skin to have a protective effect, and future research will focus on screening promising anti-*Bd* candidate bacteria based on their ability to persist on the target species.

Poster Presentations

(Alphabetical order by first author.)

Land Cover Changes Due to Agricultural Land Abandonment and Afforestation: Consequences for Stream Salamanders

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In many regions of the eastern United States forest cover is increasing due to the abandonment of marginal agricultural land. This undoubtedly leads to changes in habitat availability for terrestrial wildlife, but afforestation also has effects at the watershed level that are integrated in lower order stream conditions. Afforestation effects on streams include decreases in summer stream flows and water temperature, and an increased reliance on primary productivity driven by leaf and twig debris. These changes have far-reaching trophic consequences and presumably positive but

unknown outcomes for stream-dwelling amphibians. We are evaluating the effects of agricultural land abandonment and afforestation at the watershed scale on the diverse salamander communities of first-order streams in western New York's Allegheny Plateau. We are estimating salamander diversity and density responses to changes in watershed land cover composition, stream flow, water chemistry, and aquatic invertebrate richness. We discuss our methodological approach, including a space-for-time substitution design, and introduce preliminary results from the 2011 field season. Understanding the effects of agricultural land abandonment and afforestation on amphibians helps translating broad scale land cover dynamics into fine scale ecological processes, a step crucial to effective conservation planning.

Investigating Changes in Diamondback Terrapin Nesting Behavior in Jamaica Bay, New York

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Little is known about the process by which turtles abandon old nesting areas and colonize new nesting areas, but this process must occur with some frequency as habitats undergo succession and erosion. This must be especially rapid in areas that are highly impacted by urban development. Jamaica Bay (JB) is a large estuary in New York City whose shore lines, islands, and marshes were heavily modified in the 20th century. Many nesting and feeding sites were destroyed and some new nesting sites were created. This process is ongoing, as salt marshes in the area are currently eroding at a rapid rate. A mark-recapture study of diamondback terrapins (*Malaclemys terrapin*) has been conducted in JB since 1998 to determine whether this population is sustained by recruitment. Nearly all nesting now occurs on an island, known as Ruler's Bar Hassock that was created in the 1920s. The number of nesting females in the population has remained fairly constant at just under 1000 adults but the number of nests on Ruler's Bar has been dropping steadily and is now 37% lower than in 1999. The decrease may be the result of females moving to other sites to oviposit, perhaps sites closer to remaining marshes. A genetic analysis of the terrapins in Gateway National Recreation area is currently being conducted to better understand the history of terrapin colonization and abandonment of nesting sites in Jamaica Bay and elsewhere in the region.

Year One (2010) of the Maryland Amphibian and Reptile Atlas

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The Maryland Amphibian and Reptile Atlas is a joint project of the Natural History Society of Maryland and Maryland Department of Natural Resources. The aim of the project is to document the distribution of all amphibian and reptile species in Maryland using a systematic and repeatable approach. This is a citizen science project. Volunteers conduct the necessary fieldwork to document the presence of the 93 species of amphibians and reptiles within Maryland. Data collection began in 2010 and will continue through 2014. The Atlas is conducted on a grid-based geographic scale using U.S. Geological Survey 7.5 minute quadrangle (quad) maps equally divided into six blocks, 10 square miles each. A total of 260 quads and 1,441 blocks are covered in the Atlas. Minimum coverage goals are 25 species or 25 active search hours per quad and 10 species per block. In 2010, approximately 5,000 amphibian and reptile reports and 2,383 search hours were submitted from over 100 volunteers. Seventy-four of Maryland's amphibian and reptile species were encountered including a number of state rare and endangered species. However, the contribution of the different taxonomic groups varied. Roughly half of 2010 records were Anuran (49%). Overall, data were received from 75% of Atlas quads and 51% of blocks. Understanding distribution patterns of amphibians and reptiles is needed to create effective conservation strategies. The Atlas will establish a baseline for future efforts to determine changes in the distribution of amphibians and reptiles in Maryland.

On-Site and Off-Site Translocations of Eastern Box Turtles: Lack of Difference May Point to *Ranavirus*

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Human development represents a serious threat to wildlife populations through continued habitat loss and incidental mortality from construction activities. One approach to mitigate mortalities is to relocate individuals. The effectiveness of translocation for reptiles and amphibians has been questioned, with studies often reporting higher mortality of translocated individuals. Translocations of reptiles and amphibians predominantly involve moving an animal long distances, well beyond the individual's home range. For reptiles this means finding new nesting, foraging, and overwintering sites, which may be problematic. Conducting an "on site" translocation, within their home range, may reduce those problems. As part of the mitigation plan for the Inter-County Connecter highway construction project in central Maryland, groups of Eastern box turtles (Terrapene carolina carolina) were translocated both on-site (<0.5km), and off-site (~5km). To investigate differences in mortality among the three groups, we tracked 100 turtles (32 off-site translocation, 32 on-site translocation, and 34 non-translocation) using radio telemetry. We expected that the on-site group would have mortality rates similar to the non-translocated group, and both of these groups to have lower mortality than the off-site group. Our results however showed no difference among the three groups, with all groups having higher numbers of mortalities than we expected. Almost all of these mortalities occurred during the summer months and were attributed to disease/unknown causes. We suspect that an unforeseen

Ranavirusi infection in this population is playing a large role in the mortalities we are seeing and is likely overwhelming any differences in mortality due to the translocations.

Simultaneous Effects of a *Ranavirus* Outbreak on Amphibians and Box Turtles

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Reports of outbreaks of *Ranavirus* are becoming increasingly common, especially for amphibians. Unfortunately, information on the timing, extent, and frequency of occurrence of such outbreaks remain limited, due to the transitory nature of the disease. From 2008-2011, we studied the ecology and movement patterns of Eastern Box Turtles (*Terrapene carolina*) at North Branch Rock Creek Park in south-central Maryland. The first mortality from *Ranavirus* was seen at our study site in August, 2009, when we found seven turtles dead in the field and two turtles with apparent signs of disease. Since that time, more than 20 turtles have been found dead at our site. Results of inspection of fresh carcasses sent to the USGS Wildlife Lab confirmed that at least three of the box turtle mortalities were due *Ranavirus* infection. Although no unusual amphibian mortality was seen in 2008 or 2009, during the early spring of 2010, we began examining larval frogs (*Rana* [*Lithobates*] *sylvatica*) and salamanders (*Ambystoma opacum*) for signs of *Ranavirus* infection as well. We found multiple vernal pools where an apparent 100% of larval amphibians were infected with *Ranavirus*, later confirmed by the USGS Wildlife Lab. Mortality at these sites was an effective 100%. We found the same pattern of infection and subsequent complete mortality among larval amphibians during spring 2011 at these and additional sites. The simultaneous impacts of *Ranavirus* on amphibians and box turtles at the same site suggests a potential link, but the mechanism for this remains poorly understood.

Why Did The Terrapin Cross The Runway?

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On June 30-31 2011 domestic and international news agencies once again carried stories about diamondback terrapins (*Malaclemys terrapin*) causing departure delays at John F. Kennedy International Airport, one of the busiest airports in the world. A similar event occurred in summer 2009. These stories were generally presented as sympathetic and amusing filler pieces in which tiny turtles with amorous intent brought a major travel hub to a stop. JFK Airport is located within New York City on the eastern edge of Jamaica Bay. The airport was constructed, starting in 1942, eventually covering 2000 hectares of salt marsh with solid fill and destroying considerable amounts of terrapin habitat. Nevertheless, a large terrapin population persists, likely

in excess of >10,000 individuals, probably in nearby JoCo Marsh. Most Jamaica Bay salt marshes are eroding for a variety of reasons, but JoCo Marsh appears to be stable. Only female terrapins come on land, and only for nesting forays. Terrapins have been reported on JFK runways annually since 2000, as far back as records exist. A small number are killed each year. However, a dramatic increase in runway crossings began in 2009. We plan to determine whether this increase was due to a surge in recruitment, movement of individuals from other parts of the bay, a change in nesting behavior, or increased detection by airport personnel. Efforts are also underway to prevent terrapin access to runways; these include development of new nesting areas and barriers that will meet FAA requirements.

Variation in Salinity Aversion of Northeastern Amphibian Species May Influence Response to Anthropogenic Salinization

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Global climate change may lead to local changes in winter snowfall (and therefore application of road de-icers), as well as increased seawater incursions into freshwater habitats. Salts may contaminate local watersheds to levels high enough to potentially impact amphibian populations. Larval amphibians are often sensitive to even modest salinity increases; selection of inappropriate breeding and oviposition sites by adults could greatly decrease egg and larval survival. Adults of several amphibian species from the northeastern United States (wood frogs, *Lithobates sylvaticus*; green frogs, *Lithobates clamitans*; bullfrogs, *Lithobates catesbeianus*; northern leopard frogs, *Lithobates pipiens*; spotted salamanders, *Ambystoma maculatum*; eastern newts, *Notophthalmus viridescens*) were tested to determine whether they showed aversion to increased salinity, and if so, at what threshold concentration. Animals were individually placed in a two-compartment test chamber containing aged tap water on one side and salt solutions ranging from 0 to 500 mM (approximately equivalent to sea water) on the other side. Location and behaviors were recorded during a 10-minute trial. Species differences in threshold concentrations were observed; some species showed strong aversion to even low concentrations while others showed no aversion at all. Species with higher behavioral thresholds may attempt to breed in habitats unsuitable for successful egg and larval development. These results will help predict current and future impacts of increased habitat salinity on amphibian communities. Funding: New Jersey Water Resources Research Institute/USGS and the College of Science and Mathematics, Montclair State University.

Anatomy of a Long Term Data Set: Patuxent Wildlife Research Center's Box Turtles

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Eastern box turtles (*Terrapene carolina*) were first marked in 1942 on the Patuxent Wildlife Research Center (PWRC). A population from this refuge formed the basis of several seminal studies investigating box turtle home range, behaviors, growth and morphometrics, and population trends over time. Such long term or historical data sets are valuable tools for monitoring wildlife populations, particularly when addressing long lived species such as turtles. However over a 60-70 year period, there are changes that occur not only in terms of animal response to variables such as alterations in habitat due to forest succession or urban encroachment, but also in terms of methods in collecting and recording the data. Even with the most sophisticated models, these factors can affect how one interprets trends in animal populations. To address these issues, we have transferred to an electronic database all the historical records originally handwritten on index cards. Using this data base, we can rapidly generate histories of those turtles who have been recaptured over years. We present some of these as well as summaries on how collection of data has evolved. We also address those challenges associated with such data compiled over long periods by multiple individuals.

Compassionate Release Life: A Conservation-Focused Alternative for the Buddhist Release Life Practice

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Release Life (a spiritual practice of releasing animals that have been purchased in markets into the wild) is recognized as an important Buddhist practice to gain merit. Traditionally it is believed that, due to their longevity, turtles bring the most positive karma to the practitioners. In modern times these turtles, most often red-eared sliders (*Trachemys scripta,)* are acquired through food markets, the pet trade, poachers, and breeders. Many, if not all, of these non-native animals die slow, painful deaths in the wrong environment or worse, establish as introduced species. Red-eared sliders are listed by the ICUN as one of the top 100 most damaging invasive species. We seek to interface among citizen science, religion and culture to provide an environmentally positive alternative form of this practice. Our pilot program brought together monks, nuns and Buddhist practitioners with wildlife rehabilitators where we discussed the ways that New York's native turtles are rescued and the negative effects of non-native releases. A ceremony was conducted for 39 rescued common snapping turtle (*Chelydra serpentina)* hatchlings. The turtles were later released by the rehabilitators at an undisclosed location with appropriate habitat. Release Life is a central spiritual practice for hundreds of millions worldwide. With education and scientific collaboration, this ancient tradition has the potential to become a major conservation force and a significant source of funding.

Vernal Pool Observations Before and After Construction of a 115-kV Electrical Transmission Line Right-Of-Way in Penobscot County, Maine

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Vernal pools provide critical habitat for a wide variety of animal species. It is widely presumed that indicator amphibian species respond negatively to overstory removal. This research evaluates indicator amphibian abundance pre- and post-canopy alteration. Pools were surveyed in 2006/2007 prior to clearing activity. Construction occurred in 2008. Observers collected post-construction data for the 2009-2011 vernal pool seasons. Seven pools were selected for monitoring based on pre-construction conditions. Egg mass data were collected for wood frog (*Lithobates (Rana) sylvatica*), spotted salamander (*Ambystoma laterale*) and blue-spotted salamander (*Ambystoma maculatum*).

Preliminary results show that:

- Wood frogs: Increase in egg mass numbers from 2007 to 2009, then a slight decrease in 2010, followed by an increase in 2011.
- Spotted salamanders: Increase in egg mass numbers from 2007 to 2009, then a slight decrease in 2010, followed by an increase in 2011.
- Blue-spotted salamanders: Decrease in egg mass numbers from 2007 to 2009, followed by an increase in 2010 and 2011.

Wood frogs and spotted salamanders have a short-term response to disturbance and clearing but eventually return to pre-clearing levels. Blue-spotted salamanders are sensitive to the clearing, taking longer to return to their pools following clearing activity. Additional on-going study is intended to provide further insight to changes in habitat and the amphibians response, including how canopy removal may alter pool function.

Stream Monitoring to Identify Impacts of Oil and Gas Well Drilling in Allegany State Park Watersheds

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Recently, the Pennsylvania Department of Environmental Protection issued hundreds of permits for oil and gas wells located within the watersheds of streams flowing into Allegany State Park in Cattaraugus County, New York. To protect the important resources of this largest State Park in New York, a stream water quality monitoring program was developed and initiated in May 2010. The goal was to develop an inexpensive water quality monitoring program to provide baseline data and to document impacts related to oil and gas drilling in these watersheds. The program includes weekly monitoring of water quality parameters (e.g., conductivity, temperature, salinity, turbidity, pH, stream velocity, presence of oil). Laboratory analyses are used to back up unusual or high field results. Macroinvertebrate and stream salamander monitoring are also being conducted to further assess effects on overall stream health. To date,

results indicate that streams in watersheds undergoing significant road building and drilling activities have higher conductivity and turbidity readings. This work has resulted in one successful enforcement action against an oil company by the NYS Department of Environmental Conservation for temporary visual impacts to a stream; another enforcement action is pending. The program has alerted the oil drilling companies and Pennsylvania authorities to the environmental concerns of downstream users of water resources. This monitoring program is an example of how to obtain quality data and determine impacts with limited funding and may prove to be useful to other agencies or environmental groups as oil and gas wells are drilled in other areas.

Eastern Painted Turtles (*Chrysemys picta picta*) Use Traditional Routes When Moving Between Aquatic Habitats

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Aquatic turtles leave the water and traverse terrestrial habitats during oviposition, nesting or when the aquatic habitat becomes degraded or desiccates. Though overland movements are central to the biology of aquatic turtles, few studies have been devoted to such movements, in part because the fleeting nature of such phenomena makes them difficult to document. Using radiotelemetry, we investigated the terrestrial movements of Eastern Painted turtles (*Chrysemys picta picta*) as they left an ephemeral water source seeking new aquatic habitats. We monitored turtles at Chesapeake Farms, a 3300-acre wildlife management property where certain ponds are drained annually as part of a waterfowl management regime, enabling us to investigate how turtles naturally seek out new aquatic habitats. We radiotagged 19 adult *C. p. picta* and monitored their movements from the time they left their home pond until they reached a new, permanent water source. New water sources were 330m-850m from their home pond. Turtles followed one of four specific, directed, and intricate routes to new water sources, and animals monitored for two seasons followed the identical routes both years. These data indicate a high degree of familiarity with the habitat and these far-off water sources, a notion supported by the inability of turtles translocated to this site to locate any permanent body of water. Our results demonstrate the use of and long-term familiarity with specific regions of upland habitats and distant water sources by *C. p. picta* and underscore the importance of such habitats to the biology and conservation of aquatic turtles.

Behavior Responses of the Eastern Newt to Road Deicers

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Amphibians are highly sensitive to anthropogenic disturbances due to their permeable skin, which they use for respiration and osmoregulation. As freshwater species, amphibians should be

especially sensitive to salinization. Road deicers are significant contributors to chloride contamination in many aquatic systems. Salinization can have direct and indirect effects on local amphibian population declines (direct via egg and larvae mortality, and indirect via adult avoidance of unsuitable habitats). Few studies have tested the effects that saline environments have on adult behavior. The eastern newt (*Notophthalmus viridescens*) is of particular interest due to its unique and complex life history, including an aquatic larval stage, terrestrial 'eft' stage, and permanently aquatic or semi-aquatic adult stage. Using acute and long-term choice trials we determined the response of the eastern newt to increased salinity. It was hypothesized that the eastern newt would tolerate salinities hypoosmotic to their own estimated osmolarity and show aversion to concentrations above that point. We found that newts preferred the lowest concentrations during both the short-term and long-term choice trials. During long-term choice trials, newts were observed only in the lower salinities (0 – 0.125 M NaCl) indicating that newts were exhibiting preferences. As concentration of NaCl increased newts lost mass at a faster rate. Salinity tolerance of newt eggs and larvae has not been evaluated; because these stages are usually more sensitive than adults it is possible that newts may lay their eggs in ponds with salinities that may be detrimental to their offspring.

Integrating Climate-Smart Tools and Adaptation Strategies for Amphibian and Reptile Conservation

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The potential effects of climate change on amphibians and reptiles have been extensively discussed in the literature. With the understanding that most amphibians and some reptiles are highly vulnerable to climate change, work should now focus on methods and tools available to develop effective adaptation strategies. In this study we highlight tools available for creating adaptation strategies for climate vulnerable species. NatureServe Climate Change Vulnerability Index v.2.01 was used to determine vulnerability of amphibian and reptile species, of conservation concern, in Maryland. The Green Salamander (*Aneides aeneus*), a State Endangered species, Jefferson Salamander (*Ambystoma jeffersonianum*), a State Watchlist species, and Northern Diamond-backed Terrapin (*Malaclemys terrapin terrapin*) were chosen for this study based on their respective vulnerabilities to climate change. We demonstrate the utility of sea level affecting marsh models (SLAMM) on Diamond-backed Terrapin and species distribution modeling, under two different future climate scenarios, using Maxent on Green and Jefferson Salamanders in Maryland. Future climate scenarios were based on the Intergovernmental Panel on Climate Change (IPCC) 3rd assessment. Both techniques indicated significant changes in suitable habitat for the species of interest. In addition, we offer suggestions on interpretation and use of the models for climate-smart conservation strategies that may be implemented for these species in the face of multiple stressors. Model results can be used to hypothesize future conditions which can be monitored in an adaptive process over time. Though Maryland is used as an example, these processes and tools have application elsewhere in the northeast.

A Conservation Action Plan for the Timber Rattlesnake

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The Timber Rattlesnake (*Crotalus horridus*) is a widespread venomous viperid of the eastern North American hardwood forests. The species is characterized by late age of maturity, a low reproductive rate, and high survival rates. While stable or even experiencing a slight increase in parts of the range, in many regions the species has suffered severe decline since European settlement. A diverse group of biologists, coordinated by Earl Possardt of the US Fish and Wildlife Service, is developing a conservation action plan to determine current distribution and status, to identify threats, and to make management recommendations for preventing further declines.

Results from Frog Radio: An Automated Electronic Broadcast System to Simulate Anuran Auditory Surveys

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It is common to monitor and assess population status of anurans using auditory surveys. The ability of observers to correctly identify calls will affect the quality of survey results. However, assessing error rates is difficult when truth is not known. We present results from a controlled experiment where species of calling amphibians was known. We used a “Frog Radio” system to broadcast calls to a speaker array that mimicked natural field conditions, while 31 observers recorded observations for 12 potential species during 180 calling occasions. Observers correctly identified a calling species 80.4% of the time. However, 8.1% of all recorded detections were for species not played during the occasion. All observers made false positive detections and error rates were negatively related to self-assessed observer ability and scores on an online frog call test taken prior to the field experiment. We conducted an experiment to try to reduce false positive error rates, instructing individuals to only record species they were 100% positive occurred. The reduction in false positive errors was minor (<20%) compared to control individuals not given the instructions. It appears that most errors were due to misidentification or confusion rather than recording “ghost” species not present. For example, most errors for southern leopard frog, wood frog, and pickerel frog occurred when at least one of the others was played. Also the error rate increased as the number of species played increased. However, even for occasions where no species were played, a significant number of false positive errors occurred. Results emphasize that observer effects have important effects on the quality of survey data and the importance of training and instruction to maintain high quality control.

First Report of *Ranavirus* in New Jersey Amphibians

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While habitat loss and pollution continue to be significant threats to amphibians, emerging infectious diseases are playing a considerable role in the disappearance of these ecologically important organisms. Our research team is using molecular techniques to document and assess the prevalence of two amphibian diseases throughout the state of New Jersey. In 2009, we documented the first known occurrence of the chytrid fungus, *Batrachochytrium dendrobatidis*, in the state and now, in 2011, we report the first known occurrence of *Ranavirus* in New Jersey amphibians. Using a combination of traditional PCR and RT-PCR we show the presence of this emerging infectious disease in both Green Frog tadpoles and Fowler's Toad tadpoles at a site within the Pinelands, in Ocean County, NJ. So far, only tadpoles seem to be affected in this area, with dramatic symptoms being exhibited especially by Green Frog tadpoles, but this disease can impact both larval and adult amphibians as well as reptiles. The area is home to many reptile and amphibian species, including the threatened Pine Barrens Treefrog and the endangered Pine Snake. Little is known about the disease's ecology and transmission in the wild, or its potential impact on species already in decline. Further investigation of the extent of *Ranavirus* infection in New Jersey and its impact on both stable and declining species is critical.

Translocated Eastern Painted Turtles Do Not Successfully Navigate In Novel Habitats

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Animal translocation is a common conservation and mitigation technique, but its effectiveness and suitability for use in aquatic turtles is poorly understood. As part of an ongoing investigation into the terrestrial movements and habitat-seeking behavior of Eastern Painted turtles (*Chrysemys picta picta*), we investigated the impact of translocation on movement patterns. We translocated 10 individual *C. p. picta* from the Chester River Field Research Center (Queen Anne's Co, MD) to Chesapeake Farms (Kent Co, MD) – a straight-line distance of 11.5 mi. Using radiotelemetry, we monitored the movements of both translocated and resident turtles at Chesapeake Farms as their home ponds were drained as part of a waterfowl management program, forcing turtles to seek out new aquatic habitats. While resident turtles located far-off permanent bodies of water quickly and easily, all translocated turtles failed to do so, wandering about the habitat without direction. Even when portions of their routes overlapped with those of resident animals, translocated animals were unable locate water, indicating that they were unable to navigate novel habitats using sensory information alone. Relative to resident turtles, translocated turtles were slower to initiate overland movements, traveled greater distances at slower rates, and changed direction more frequently and to greater degrees. Finally, translocated animals moved in irregular, non-linear patterns and did not avoid wooded areas, contradicting

predictions from previously published work. Our results demonstrate the importance of habitat familiarity to directing turtle movements and call into question the suitability of translocation as a conservation method for aquatic turtles.

The Response of Anuran Distributions to Anthropogenic Disturbance: A Proposal to Use Circuit Theoretic Analysis to Model Landscape Connectivity

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Species conservation strategies emphasize preserving fragmented habitat patches as reserve networks embedded in a landscape matrix of anthropogenic land use. Landscape connectivity is critical to maintaining viable populations within reserve networks and is a function of the matrix's resistance to an organism's movement. As land use within the matrix varies it can be expected that landscape connectivity will vary as well. Our study proposes to model Anuran, frog and toad, species distributions in relation to anthropogenic variation in landscape matrix connectivity. We will use calling survey data of breeding Anurans to model occupancy probabilities in potential breeding ponds in eastern Virginia. In a Geographic Information System environment, we will conduct a circuit theoretic analysis of landscape connectivity using Anuran occupancy data and spatial datasets of landscape and anthropogenic features known to influence matrix permeability. Circuit theoretic analysis is a novel approach to modeling landscape connectivity as it applies the principles of resistance and current to a continuous landscape surface. The output of this analysis will be used to predict the distribution of Anuran species at unsurveyed sites throughout our study area. We intend to validate our model predictions with further calling surveys and subsequently re-parameterize the model with our findings. Our connectivity model will enable land managers to evaluate the impacts of proposed land uses on landscape connectivity and Anuran population viability.

Conservation of the Eastern Box Turtle during a Major Highway Construction Project in the Greater Washington Metropolitan Area

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The eastern box turtle (*Terrapine carolina carolina*) is a declining terrestrial reptile species in Maryland, and has been classified as a species of "Greatest Conservation Need" by the Maryland Department of Natural Resources. Declines have been attributed to loss of habitat and fragmentation from land disturbance activities including development and road building. The Intercounty Connector (ICC) highway project is an approximately 18-mile new highway being constructed within the greater Washington metropolitan area of Maryland. As an Environmental Stewardship effort by the project, the Maryland State Highway Administration (SHA)

implemented conservation measures to reduce mortality of box turtles during road construction. A panel of box turtle experts was convened by SHA to help guide highway contractors in finding, removing, and excluding box turtles from active construction areas and relocating them to nearby suitable habitat. From fall 2007 to fall 2009, 898 box turtles were collected using a combination of human and canine searching techniques and relocated from the project corridor. Box turtle relocation techniques, successes, and failures are discussed.