Caribbean Biodiversity: The Case of Puerto Rico

Rafael L. Joglar. Department of Biology, University of Puerto Rico at Rio Piedras; Director, Proyecto Coquí.

The Caribbean Islands are consider a biodiversity hotspot and they are extremely rich in biodiversity, endemics and endangered species. Puerto Rico is the smallest of the Greater Antilles with a total area of 8,900 km\(^2\). Despite its small size Puerto Rico has 11,410 species of animals, 3,000 species of plants and 12,000 species of fungi. The herpetofauna of Puerto Rico consists of 26 species of amphibians (19 native, seven introduced) and 56 species of reptiles (52 native, four introduced). At least one fourth of these species are endangered or threatened. Our research from 1986 to 2012 documents that the conservation of these species has been an exercise in futility since it has been limited to prepare threatened and endangered species lists that are not updated regularly and that have very little to do with the population status of these species. Government agencies responsible for biodiversity (state and federal) have favored birds and mammals over amphibians and reptiles in terms of research and protection and have ignored several important issues: (1) invasive species, (2) pathogens (such as \( Bd \)), (3) climate change; and (4) the fact that Puerto Rico is a small, overpopulated island with enormous pressure of unsustainable development. To improve the conservation of Puerto Rican biodiversity it is important to sponsor (1) scientific research with emphasis on field work, (2) habitat protection with emphasis in land acquisition and (3) environmental education done by professionals. It is also necessary to (1) increase the budget of government agencies and NGO’s involve in biodiversity conservation and (2) reestablish conservation priorities.

A case study of a pathogenic fungus in an amphibian-rich tropical island: extinctions, declines and persistence.

Burrowes, Patricia A.\(^1\), Rafael Joglar\(^1\) and Longo, Ana V. Longo\(^2\). Universidad de
We report on our findings of the effect of the chytrid fungus Batrachochytrium dendrobatidis (Bd) among Puerto Rican anurans. Detailed studies in two species, *Eleutherodactylus coqui* y *E. portoricensis* at El Yunque, revealed long term population fluctuations that allow us to understand the effect of this pathogen in species that persist after an epidemic. In the field we used marc-recapture to monitor the status of *Bd* infection and estimate the probability of survival of infected versus non-infected adults. We compared prevalence (# of infected frogs/total sampled) and intensity of infection (# of *Bd* zoospores) between juveniles and adults in two localities, Palo Colorado (661 m) y Bosque Enano (850 m). Results revealed that both species continue to decline at Palo Colorado, while in Bosque Enano, *E. portoricensis* has recuperated from drastic declines. Age, Season, and elevation significantly predicted the number of *Bd* zoospores in frogs. Age, is also significantly associated to high levels of infection, and *Bd* prevalence is higher in juveniles than adults in all populations studied. We suggest that juveniles represent a critical stage for survival of direct-developing frogs infected with *Bd*. The probability of survival was higher for non-infected frogs, but the difference in recapture rate between infected and non-infected adults was significant only for Palo Colorado, suggesting that the negative effect of *Bd* under enzootic conditions was greater at mid-elevation sites. *Ex-situ* laboratory experiments corroborated effect of seasonality on frog susceptibility to *Bd*, pointing to extended droughts as the time when frogs are more likely to die from chytridiomysosis. Our work contributes to the understanding of how terrestrial direct-developing frogs persist with *Bd*, suggesting a critical age class, and environmental synergies that may drive population fluctuations and/or declines in nature.


Carlos C. Martinez Rivera, PhD. The Philadelphia Zoo.

Nowhere else are amphibians in more need of help than in the Caribbean. The five countries in the World with the highest percentage of threatened or extinct
amphibians are all in the Greater Antilles. On top of the list is the island of Hispaniola (Haiti and Dominican Republic) with the highest percentage of threatened amphibians [Dominican Republic = 83% (31/36) in Haiti = 96% (54/58)]. In both countries the key threats are large-scale deforestation and habitat degradation. If we are not able to implement sensible solutions for this crisis, these two countries may lose their amphibian fauna in less than 20 years, causing an unnatural imbalance in the ecology of the remaining natural habitats and prompting the collapse of already fragile ecosystems.

We will: 1) Monitor endangered amphibian populations in Massif de la Hotte and Massif de la Selle in Haiti and Sierra de Bahoruco and Bahoruco Oriental in the Dominican Republic; 2) Use this data to understand how species cope with extreme habitat loss, and if there are functional populations in such a degraded and fragmented landscape; 3) Work with local NGO’s and government agencies to develop and implement regional species population management and conservation plans; and 4) Rescue some of the most critically endangered Haitian amphibians in captive breeding programs in Haiti that would allow their reintroduction once the necessary measures have been set in place and some of these areas are protected and restored.

BIOLOGY OF THE CRITICALLY ENDANGERED CUBAN CROCODILE (CROCODYLUS RHOMBIFER) AND THREATS OF HYBRIDIZATION

Kent A. Vliet, Ph.D. University of Florida, Department of Biology, Gainesville, FL

The Cuban crocodile (Crocodylus rhombifer) is a medium-sized crocodile endemic to the Zapata and Lanier swamps of Cuba. This robust and powerful crocodile is highly agile on land as well as in the water and appears to have occupied niches vacated by the loss of terrestrial mammalian predators. The Cuban crocodile is critically endangered. It has the smallest natural range of any crocodilian. Population numbers are not well known but are undoubtedly limited to a few thousand individuals. Recent intrusion of swamp habitats by Crocodylus acutus has
led to widespread hybridization between the two species. The impact and historical ramifications of this hybridization will be discussed.

**Using models of amphibian response to climate change in the southeastern US to identify conservation priorities and uncertainties.**

Kyle Barrett*, John C. Maerz, Nathan P. Nibbelink. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602

Projecting effects of climate change on organisms presents a significant challenge to ecologists, conservationists, and natural resource managers. Modeling has emerged as the preeminent tool for understanding how species will respond to climate change, since experimentation is not amenable to the large number of areas and species in need of management. Amphibians are one of the world’s most imperiled taxa, which makes understanding their response to climate change extremely important. We surveyed wildlife managers responsible for amphibian monitoring and management in each of eight southeastern states to identify the five amphibians that they were most concerned with in the face of climate change. We then forecast the distribution of suitable climatic habitat for these species across the southeast using a range of scenarios. The survey of state priority species resulted in a list of 16 salamanders and 5 frogs. Areas with suitable climates are projected to decrease for all species but one by 2050; however, wide-ranging species that extend beyond the southeast are projected to fare better than species with small ranges. For example, the Eastern Tiger Salamander is projected maintain 62% of currently suitable climatic habitat by 2050, while the Gopher Frog is projected to only maintain 4% under the same climate scenario. In addition to identifying species most at risk to changing climates, these models identify areas most valuable to species protection in the future. We discuss the applications of the models and we identify how model uncertainty can be assessed and used along with model output.

Kyle Barrett has worked as a Postdoctoral Research Associate at the University of Georgia since 2009, when he received his PhD from Auburn University. He is interested in researching how large-scale environmental stressors such as urbanization and climate change influence the distribution and ecology
of amphibians and reptiles. Kyle is currently involved several climate change vulnerability assessments for amphibians, and teaches course on conducting vulnerability assessments for the US Fish and Wildlife Service.

EVALUATING VULNERABILITY OF SANDHILLS HERPETOFAUNA TO CLIMATE CHANGE.
Kimberly M. Andrews* and Tracey D. Tuberville, University of Georgia’s Savannah River Ecology Lab, Aiken SC 29802

Due to their sensitivity to slight changes in their environments, ectotherms (particularly reptiles and amphibians) serve as ideal taxa for which to develop and perform climate change vulnerability assessments. In addition, reptiles and amphibians collectively possess a wide range of life history, physiological and behavioral traits that presumably translate into variability among species in their ability to acclimate and/or adapt to changing conditions. The Sandhills Ecoregion has among the highest diversity of reptile and amphibians, including species that are endemic or otherwise have restricted distributions. Ranking species based on these biological traits will aid in assessing vulnerability of extant species to climate changes predicted to occur in the region over the next 50 years. We used NatureServe’s Climate Change Vulnerability Index (CCVI) to predict the relative vulnerability of Sandhills herpetofauna, identify potential species at risk, and evaluate common factors contributing to their vulnerability. However, we found that the CCVI did not capture all of the life history traits and natural history characteristics that might contribute to their vulnerability. We will present the quantitative results of the CCVI analysis, provide recommendations for additional factors to consider, and propose additional potentially vulnerable species based on those factors.

BIO: Andrews holds a joint position between Jekyll Island Authority’s Georgia Sea Turtle Center as the Research Coordinator and UGA’s Savannah River Ecology Laboratory where she conducts various research and outreach activities. She completed her Ph.D in 2010 from the UGA Odum School of Ecology. Her research focuses on wildlife conservation and the spatial ecology of reptiles in
urbanizing landscapes. She works with developers, planners and transportation professionals to target more sustainable planning regimes for small vertebrates.

RESTORING WETLANDS TO BENEFIT REPTILES AND AMPHIBIANS.

Thomas R. Biebighauser,* US Forest Service, Center for Wetlands and Stream Restoration, 2375 Highway 801 South, Morehead, KY 40351

Wetlands provide critical habitat to many amphibians and reptiles. Unfortunately, many of these ecosystems have been lost to draining and filling across the Southeast. Historic changes to public and private lands are now affecting recovery efforts for rare species, reducing water quality, increasing flooding, and lowering groundwater elevations. Fortunately, it is possible to construct wetlands that look and function like natural wetlands. Techniques developed by the Center for Wetlands and Stream Restoration are producing wetlands with desired hydroperiods, aquatic vegetation, and animal life. Examples of how wetlands have been established on mountain ridge-tops, in large valleys, from old roads, and within electric transmission line corridors will be described. You’ll see how wetland projects can be planned in forested and open areas, on mined lands, and in urban areas to benefit herps, plants, and communities.


SAVING OUR ENDANGERED HERPS: HOW PARTNERING WITH LAND TRUSTS CAN HELP ADVANCE THE MISSION OF SEPARC

Kyle Pursel*, Highlands-Cashiers Land Trust, Highlands, NC 28741

Land trusts are quickly becoming the major means of land protection in the United States. Over 47 million acres of land are currently protected by land trusts, and thousands more acres are added each year. More importantly, land trusts are
sometimes the only major means to protect important local ecological resources. Learn about land trusts, what they do, what is a conservation easement, and how conservation easements can be used as a cheaper tool to protect land than direct land purchases. Also learn how researchers and conservationists alike can benefit from partnering with land trusts to conduct research, conserve key habitats, and create informed management plans to help protect rare and endangered reptiles and amphibians in the southeast and beyond. Similarly, learn how you can help land trusts develop plans to properly target and manage properties containing key habitats for rare species, initiate reintroduction programs, identify and survey for rare reptiles and amphibians, or simply through general volunteer work.

Kyle Pursel started with the Highlands-Casheirs Land Trust in 2010 as their stewardship coordinator and is currently finishing is M.S. at Western Carolina University under Dr. Joe Pechmann. Kyle is interested in community interactions of reptiles and amphibians and in using science to help protect rare species and habitats. Kyle’s MS research focused on the impacts of rhododendron on Southern Appalachian salamander communities.

**URSPELERPES BRUCEI: DISCOVERY, NATURAL HISTORY, AND A WARNING FOR AMPHIBIAN CONSERVATION.**

Todd Pierson* and John Maerz, Warnell School of Forestry and Natural Resources, University of Georgia, Athens GA 30605

Discovered in 2007, Urspelerpes is the first new genus of North American salamander since Phaeognathus in 1961. Despite active searching since the discovery, it is still known from less than three square miles in northeastern Georgia and neighboring South Carolina. We used leaf-litter traps to sample three known localities for *U. brucei* in Georgia in order to calculate a detection rate for this species. Our discovery of an exceptionally low detection rate suggests the difficulty of surveying and monitoring this species and emphasizes the inescapability of uncertainty when studying amphibians. We will highlight this research in addition to reviewing the discovery and basic natural history of Urspelerpes brucei, giving an update on the status of this species since its discovery nearly five years ago.
Todd Pierson is an undergraduate in the Odum School of Ecology at the University of Georgia, set to graduate in May 2013. His main interests lie in amphibian and reptile conservation and ecology domestically and internationally, as he has been involved in research trips to Guatemala, Honduras, Nicaragua, Oman, and the United Arab Emirates in the last year and will travel to China and South Korea in coming months.

THE IMPORTANCE OF CAVES FOR PLETHODONTID CONSERVATION.

Matthew L. Niemiller1*, Dante B. Fenolio2, and Brian T. Miller3.

1 Department of Ecology & Evolutionary Biology, Yale University, New Haven, CT 06511
2 Center for Conservation, Atlanta Botanical Garden, Atlanta, GA 30309
3 Department of Biology, Middle Tennessee State University, Murfreesboro, TN 37132

Only a small fraction of salamanders obligately occur in subterranean habitats in the United States. These species have evolved morphological, physiological, and behavioral adaptations to permanently persist and exploit subterranean realms. However, caves and other karst habitats are often underappreciated and overlooked as significant habitat for many other salamander species, particularly plethodontids. Although the occurrence of many species in caves can be categorized as accidental, several species use caves on a temporary or semi-permanent basis for shelter, foraging, or reproduction in karst areas, including several salamanders that rely on cave habitats to complete some aspect(s) of their life histories. Here we discuss the use and importance of cave habitats for plethodontid salamanders occurring in the southeastern United States. We advocate that caves are critical habitats for many species and should not only be included in field surveys but should be protected for proper plethodontid conservation and management.

A review of the obligate subterranean caudates of North America with emphasis on new work with the Georgia Blind Salamander, Haideotriton wallacei.

Danté B. Fenolio, Matthew L. Niemiller, and Ronald M. Bonett
Organisms inhabiting extreme environments teach us about the flexibility of life through adaptation in morphology, ecology, and behavior that often demonstrate unique and unusual phenotypes. Salamanders have successfully exploited the extreme environments of subterranean waters that lack light and often are limited in food and nutrient resources; however, science is just beginning to unravel the complexities in biodiversity, adaptation, and population ecology of stygobitic caudates. Technological advancements, intensified cave exploration, and contemporary genetic analyses have produced a rapidly expanding list of species that are adapted and restricted to subterranean habitats, with at least 11 species occurring in North America and more species are expected to be recognized in the near future. One convergent characteristic in all but one or two of the North American species is paedomorphosis, whereby salamanders maintain a larval morphology and achieve reproductive maturity, all the while living in persistent bodies of water (groundwater). This strategy may be advantageous when aquatic environments are more productive, or terrestrial habitats are inhospitable or nonexistent. Little is known about the life history strategies or population ecology of many subterranean salamanders. Perhaps the most enigmatic of the groundwater caudates is the Georgia Blind Salamander, *Haideotriton wallacei*. Almost nothing is known of the reproductive biology of this species nor has any study clarified population ecology, behavior, genetic similarities/differences between known populations, etc. In fact, the limits of its range are not even clearly defined owing to the inaccessibility of the habitat within which the salamander lives. Because these salamanders inhabit groundwater, any study aiming to clarify their biology and ecology will be a challenge; a team of biologists aims to decipher some of the questions surrounding this species. A facility to maintain captive individuals has been established at the Atlanta Botanical Garden with the intent to reproduce this species in captivity. Additional studies are also underway including genetic analyses and testing for emergent infectious amphibian disease.

**SALAMANDER RESPONSES TO ANTHROPOGENIC DISTURBANCE.**
Kristen K. Cecala* and John C. Maerz, Warnell School of Forestry
Changes in behavior can alter movement patterns of animals, which can impact patterns of occupancy among habitats and fragment populations. Evolutionary theory predicts that animals have evolved to move in response to a suite of cues that maximize animal survival and growth and minimize risk of injury or mortality. Behavioral plasticity allows these animals to adjust their behavior to appropriately respond to variable cues. When humans modify environments, new conditions can suddenly yield maladaptive responses to cues that were adaptive in the undisturbed environment. Headwater streams generally have dense over- and mid-story canopies that limit direct light penetration and moderate values and ranges of light intensity, temperature, and humidity known to affect salamander behavior. We tested whether canopy gaps in otherwise natural systems could 1) alter salamander responses to light cues, and 2) fragment previously contiguous populations. Controlled laboratory tests indicated that salamander larvae exhibit strong, negative phototaxis that can be mediated by different stream substrates. Secondly, reciprocal transfers across a canopy gap and within forested areas demonstrated that salamanders were approximately 50% less likely to home to their capture location if a gap was present. This study demonstrates that behavioral plasticity allowed salamanders to adapt to high light environments, but the interactive effects of substrate were important to consider. Field experiments indicated that despite this plasticity, small canopy gaps (< 15 m) were capable of inhibiting homing behavior. Canopy gaps are a ubiquitous consequence of anthropogenic activity, precede more intensive development, and may yield unforeseen consequences for stream populations.

Kristen Cecala is a current Ph.D. student at the University of Georgia working with Dr. John Maerz in applied ecology. She completed her undergraduate degree working with amphibians and reptiles at Davidson College with Dr. Michael Dorcas. Kristen works collaboratively with the Coweeta LTER Site to examine how ex-urban development in the southern Appalachian Mountains is affecting stream amphibians and other stream processes.
The effects of prescribed fire on amphibian and reptile diversity in an oak-grassland restoration area.

ROBERT KNOPP* and HOWARD WHITEMAN, Department of Biological Sciences and Watershed Studies Institute, Murray State University, Murray, KY 42071.

Historically, natural wild fires often swept through forests and grasslands, reducing plant biomass and affecting surrounding faunal communities. Prescribed fire management is a frequent tool in habitat restoration, yet the effects of such management on herpetofauna need to be better understood, because herpetofauna are a significant but underappreciated component of forest communities. We predicted that species adapted to drier and warmer environments would be more abundant in fire-managed habitats, outcompeting and filling niches at a higher rate than water dependent species, due to higher light levels, lower leaf litter, and less course woody debris (CWD) in such areas. Our study focused on eight wildlife ponds within a restoration burn area and eight similar ponds in an adjacent non-restored forest within Land BetweenThe Lakes National Recreation Area. All ponds were sampled using dip-nets and minnow traps during June- August 2011, and drift fences were checked daily for captured animals from September through October. Amphibian larvae were captured and identified to species, and all herpetofauna found at fences were recorded. Data analysis is ongoing and our preliminary results will be discussed.

MORTALITY AND MANAGEMENT: ASSESSING DIAMONDBACK TERRAPINS (MALACLEMYS TERRAPIN) ON THE JEKYLL ISLAND CAUSEWAY.

Brian A. Crawford1*, John C. Maerz1, Nathan P. Nibbelink1, Kurt A. Buhlmann2, Terry M. Norton3, 1Warnell School of Forestry and Natural Resources, University of Georgia. Athens, GA 30602, 2Savannah River Ecology Lab, Odum School of Ecology, University of Georgia, Aiken, SC 29802, 3Georgia Sea Turtle Center, Jekyll Island, GA 31527.

Conservation of declining species relies on identifying threats, predicting their impacts, and mitigating these risks with specific solutions. Diamondback
terrapins (Malaclemys terrapin) are declining or of unknown status across the majority of their range due to multiple anthropogenic threats, including road mortality of adult females. Throughout the summers of 2009 to 2011, we used mark-recover techniques and intensive road surveys of a heavily used causeway to Jekyll Island, Georgia, USA to 1) estimate terrapin population growth given current threat levels and 2) determine if there were predictable spatial (hot spots) and temporal (hot moments) peaks of terrapin road-crossing activity to inform management strategies. Stage-based population models showed modest to severe declines (0.810 < λ < 0.971) under current rates of adult road mortality. We found 30% of terrapins crossing in 3 discrete hot spots that composed less than 10% (~800 m) of the length of the entire causeway. Temporally, we observed 55% of terrapins on the road within a 3-hr window during the diurnal high tide, and terrapins were most likely to be on the JIC early in the nesting season. Peaks were consistent across study seasons. These results yield a firmer understanding of the characteristics and probable impacts of road mortality on terrapin populations and can directly influence mitigation strategies for this and other causeways.

Brian A. Crawford received a B.S. in Ecology from the University of Maryland in May 2008. After working on multiple herpetofauna projects at the Savannah River Ecology Lab, he completed an M.S. in wildlife conservation from the University of Georgia in December 2011 focused on road mortality of diamondback terrapins. He plans to continue this research through a PhD degree at UGA and is interested in wildlife conservation management, population modeling, and spatial ecology.

**Isolation of frog virus 3 from pallid sturgeon suggests an interclass host shift**

Thomas B. Waltzek, Debra L. Miller, and Matthew J. Gray. Department of Environmental and Global Health, University of Florida, Gainesville, FL 32610 (Waltzek); Center for Wildlife Health, Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN 37996 (Gray, Miller)

During July – September 2009, juvenile pallid sturgeon (Scaphirhynchus albus) at the Blind Pony State Fish Hatchery (BPSFH) in Sweet Springs, Missouri experienced mortalities of over 500 individuals/day at water temperatures between
16 – 26 C. Histological exams revealed extensive necrosis of the hematopoietic tissues. A viral replicating agent was observed in cell culture and confirmed by electron microscopy. Experimental infection studies revealed the virus is pathogenic to pallid sturgeon – a federally endangered species. Analysis of the full length major capsid protein revealed that it was identical to the type species of ranavirus, Frog Virus 3 (FV-3), and to a previous BPSFH isolate. This suggests that recurring infections or carryover of the virus from prior groups of sturgeon may have maintained the virus at this facility. Inasmuch as the BPSFH draws water directly from nearby Blind Pony Lake without disinfection, entry of ranavirus-contaminated water into the facility cannot be ruled out. However, liver samples collected from adult and larval American bullfrogs (Lithobates catesbeianus) and plains leopard frogs (Lithobates blairi) during the fall of 2009 and 2010 in nearby wetlands were negative for FV-3. The potential for reciprocal FV-3 infections (i.e. amphibian to fish and vice versa) has only been reported in sympatric populations of threespine stickleback (Gasterosteus aculeatus) and red-legged frog tadpoles (Rana aurora). Future research will focus on discovering the source of the virus at the facility (e.g. contaminated water supply, broodstock, etc...) as well as testing the host specificity and pathogenicity of the virus across a suite of poikilothermic vertebrates.

Ranaviruses can be transmitted across ectothermic vertebrate classes.
Matthew J. Gray*, Thomas B. Waltzek, and Debra L. Miller. Center for Wildlife Health, Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN 37996 (Gray, Miller); Department of Environmental and Global Health, University of Florida, Gainesville, FL 32610 (Waltzek)

Phylogenetic studies suggest that ranaviruses evolved in fish and radiated to reptiles and amphibians several million years ago. Ranaviruses isolated from fish, reptiles and amphibians can have >99% sequence homology for a small, conserved region of the major capsid protein; however to date, no studies have demonstrated that a ranavirus isolated from one vertebrate class is capable of infecting a different class. We isolated FV3-like ranaviruses from a morbid pallid sturgeon
Scaphirhynchus albus), box turtle (Terrapene carolina) and bullfrog (Lithobates catesbeianus), and tested whether interclass transmission was possible. Experiments were conducted under controlled, replicated laboratory conditions. We exposed tadpoles of three amphibian species (L. sylvaticus, Hyla chrysoscelis, and L. catesbeianus) to the turtle and pallid isolates, and red-eared slider (Trachemys scripta elegans) hatchlings to the bullfrog and pallid isolates. Virus exposure was via water bath (103 PFU/mL) and included controls. In addition, we tested whether turtle hatchlings could become infected by eating dead, infected L. sylvaticus tadpoles. The pallid isolate caused rapid (days to first death = 6 d) and significant mortality among amphibian species (L. sylvaticus, 95%; H. chrysoscelis, 85%; L. catesbeianus, 80%). In addition, mortality of turtle hatchlings exposed to the pallid isolate was 35% and 45% in the water bath and tadpole consumption treatments (days to first death = 12 d). The turtle isolate caused only 5% mortality in L. sylvaticus tadpoles. The bullfrog isolate did not cause death in the turtle hatchlings; however, 10% of individuals were infected. Our results demonstrate that ranavirus transmission is possible among ectothermic vertebrate classes.

Matt Gray is an associate professor of wildlife ecology at the University of Tennessee (UT) and a member of the UT Center for Wildlife Health. His research on ranaviruses has focused on identifying mechanisms associated with ranavirus outbreaks. He is a member of the Global Ranavirus Consortium (http://fwfag.utk.edu/mgray/ranavirus/Ranavirus.htm).

Investigations of American Alligator Habitat Use and Populations in Freshwater Lagoon Systems in Urbanizing Landscapes

*Gregory M. Skupien1 and Kimberly M. Andrews1,2 Island Authority, Georgia Sea Turtle Center, Jekyll Island, GA 31527 of Georgia, Savannah River Ecology Laboratory, Aiken, SC 29802

American alligators (Alligator mississippiensis) are an influential component of coastal ecosystems, especially in coastal habitats where they are the only large carnivorous predators. As apex predators, they regulate aquatic and surrounding terrestrial environments. Additionally, they are dispersing animals
that establish site fidelity and aggressively defend their territory. These biological patterns arouse strong emotional responses over the welfare of pets and family members in developing areas where alligators are present. The magnitude of these concerns has increasingly demanded intervention and explanation by a third party that often includes government officials, wildlife control agents, and scientists. These groups of experts agree that ignoring these concerns is unacceptable as our response system is not yet standardized and the complexity of managing this game animal in a diversity of scenarios is increasing. Further, harvesting regimes for removal of nuisance alligators may only be partially effective. One must presume that if the habitat was sufficient for establishment of a problematic alligator, the site will attract another individual to fill the open niche. Education, along with supplemental actions that appease these concerns, is necessary. We present initial findings from a multi-faceted research project that employs 1) count surveys and mark recapture, and 2) telemetry and space use assessments to understand basic biological components such as population levels and movement patterns of resident alligators. Data-based solutions founded on biology and engineering can influence and inform the spatial distribution of alligators in these urbanized habitats and reduce risk to human residents while maintaining population viability of alligators.

BIO: Skupien received his B.S. in Zoology with a certificate in Environmental Studies from the University of Wisconsin-Madison. He has been a technician in the Research department at the Georgia Sea Turtle Center for the past year and initiated the Jekyll Island Alligator project in coordination with Kimberly Andrews. His professional interests focus on wildlife conservation of perceived nuisance animals and translating biological field data into management recommendations and public awareness efforts to reduce human-wildlife conflict.

USING ENVIRONMENTAL DNA TO DETECT HELLBENDER (CRYPTOBANCHUS ALLEGANIENSIS) PRESENCE IN TENNESSEE AND GEORGIA.

Stephen F. Spear1,2*, Michael Freake3, Christopher L. Jenkins1, and Lisette P. Waits2, 1The Orianne Society, 579 Highway 441 S, Clayton, GA 30525, 2Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844, 3Department of Natural Sciences and Mathematics, Lee University, Cleveland, TN 37311.
The use of environmental DNA (eDNA) collected from water samples represents a promising cost-efficient method for detecting rare species of amphibians. Previous researchers have successfully detected DNA in water samples for bullfrogs in France, carp in the Great Lakes and stream amphibians in Idaho. We sought to test the efficacy of this method for detecting hellbender presence in both known and historic streams in Tennessee and Georgia, and then compare results to survey data. We filtered 3 1-liter water samples from 19 sites in eastern Tennessee and north Georgia, as well as a liter of deionized water at each site to test for contamination. We identified a 98 base pair region of cytochrome b mitochondrial DNA that was unique to hellbenders, and amplified successfully in samples extracted directly from hellbender tissue. For each sample, we ran 3 different trials to evaluate consistency of results. We found consistently high detection of hellbender DNA in all streams known to have current hellbender presence, regardless of density. Furthermore, we detected hellbender presence in several historic streams in which hellbenders had not been recently detected by traditional survey methods. However, we did detect evidence of contamination in a few instances, which we determined to be most likely due to the field methodology used. Therefore, we demonstrate that the eDNA is highly effective for detecting hellbender individuals, but field protocols must be carefully developed to eliminate cross-contamination.

Stephen F. Spear is a postdoctoral research scientist with The Orianne Society and is located at the Lab of Ecological, Evolutionary, and Conservation Genetics at the University of Idaho. He received his Ph.D in Zoology at Washington State University in 2009, his MS in Biology at Idaho State University in 2004, and BS in Biology at University of Richmond in 2001. His research interests include landscape genetics, spatial modeling and conservation of herpetofauna.

RANGE-WIDE POPULATION GENETIC STRUCTURE OF THE GOPHER TORTOISE (GOPHERUS POLYPHEMUS).

Daniel L. Gaillard*, The University of Southern Mississippi Dept of Biological
The gopher tortoise (Gopherus polyphemus) has undergone a range-wide decline over the last century, and their numbers continue to decline as viable habitat continues to be fragmented or degraded. Population genetic approaches are increasingly being used to identify issues and guide management in the face of such trends. Previous work in the eastern portion of the range found that populations in Florida and southern Georgia do exhibit genetic structure. Also, work in the western portion of the range has shown that western populations have lower genetic diversity than their eastern counterparts. Our goal is to build upon published research by including portions of the range that have not previously been studied.

We genotyped approximately 900 individuals at 20 microsatellite loci from 42 sites. On average eastern populations have higher genetic diversity than do their western counterparts and populations located on the periphery of the range tend to be lower in genetic diversity as well. We also found that gopher tortoises have distinct genetic structure across their range, with major rivers potentially being strong barriers to gene flow.

Daniel Gaillard began working at The University of Southern Mississippi in May of 2009 after completing his undergraduate degree from The University of Memphis. His research involves reptiles, with specific interests in invasive species, population/conservation genetics and diet/nutrition. He is currently working on a range-wide population genetics study of the gopher tortoise (Gopherus polyphemus).

COMPARING GENETIC VARIATION OF ADULT AND HATCHLING GOPHER TORTOISES (GOPHERUS POLYPHEMUS) FROM SITES IN MISSISSIPPI WITH VARYING LEVELS OF RECRUITMENT.

Angela H. Getz*, Daniel Gaillard, Aaron Holbrook, Brian Kreiser, and Carl Qualls.
Department of Biological Sciences, University of Southern Mississippi, Hattiesburg, MS 39406

Despite the protection of gopher tortoises in the western portion of their
range for over twenty years, populations of the Desoto National Forest (DNF) in southern Mississippi experience low recruitment and lower hatching success than populations in the eastern portion of the range, and the causes of this are unknown. Previous work has shown that Mississippi populations of the DNF have lower levels of genetic diversity than eastern populations, which prompted the suggestion that reduced levels of genetic variation may play a part in low hatching success. A recently discovered population of gopher tortoises in Hillsdale, Mississippi has an unusually high proportion of small juvenile and sub-adult burrows suggesting that there is higher recruitment there compared to populations of the DNF. This provided us with an opportunity to see if the higher level of recruitment at this site might be correlated with a higher level of genetic diversity. We used 9 microsatellite loci to genotype adults and hatchlings from this high recruitment population (Hillsdale) and a low recruitment DNF population (Camp Shelby: T44). Measures of genetic diversity (number of alleles, heterozygosity, and percent polymorphic loci) were compared between the two sites as well as between adults and juveniles within each site. We also compared the level of genetic diversity between late-stage embryo mortalities and successful hatchlings.

Angela Getz obtained a B.S. in Biological Sciences from Mississippi State University and then participated in a post baccalaureate extensive study program at the Genome Institute at Washington University in St. Louis. She is currently pursuing a master's degree at the University of Southern Mississippi. Her thesis work takes a genetic approach to examining survival and recruitment in gopher tortoise populations.

LANDSCAPE-SCALE CONSERVATION GENETICS OF HOGNOSE SNAKES (HETERODON SIMUS, H. PLATIRHINOS).


The southern hognose snake, Heterodon simus, is a fossorial snake whose range is restricted to the southeastern Coastal Plain. The species is infrequently encountered, perceived as rare, and considered extirpated from large portions of its
former range. In contrast, its congener—the eastern hognose snake (H. platirhinos)—is still relatively common. Both species occur on the Savannah River Site (SRS), South Carolina, where locality records have been maintained for more than 50 years. In addition, more intensive research on both species was initiated in the late 1990s, using radio-telemetry to investigate activity and movement patterns and to develop resource use models. Combined, these data suggest that, compared to the more common eastern hognose snake, the southern hognose snake: a) has a more disjunct landscape-scale distribution, b) is more restricted to xeric habitats, c) has a shorter period of seasonal activity, and d) has smaller home ranges. Southern hognose snakes appear to occur in more isolated populations and individuals have more restricted movement and activity patterns. Thus, geographic distance is more likely to function as a barrier to genetic exchange between populations and to colonization of new or unoccupied sites (i.e., such as recently restored habitat).

Using nearly 200 samples collected from the SRS, we compare the conservation genetics of eastern and southern hognose snakes at the landscape level using microsatellite markers. We will present preliminary results and provide management recommendations based on those results.

Tracey D. Tuberville is an Assistant Research Scientist at the University of Georgia's Savannah River Ecology Lab in Aiken, SC. Her research interests including conservation and management of reptiles and amphibians, including population manipulations such as translocation and head-starting, and use of genetic markers to understand individual behavior and population processes of captive and free-ranging wildlife populations. The project she is going to present today was funded in part by Orianne Society in 2011.