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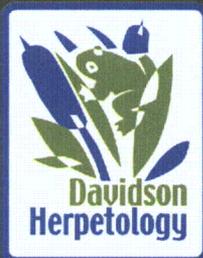
Herpetological Surveys of the Railroad Corridor between Gaffney and the W.S. Lee III Nuclear Station, Cherokee County, SC



by Michael E. Dorcas

24 August 2009

Herpetology Laboratory
Department of Biology Davidson College



Purpose

This report describes the results of field activities conducted from February to July 2009 to survey for amphibians and reptiles that inhabit the railroad corridor between the Ice Plant at Gaffney and the W.S. Lee III Nuclear Station, Cherokee County, SC.

Suggested Citation

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Cover Photograph

Bullfrog (*Rana catesbeiana*) photo taken by M.E. Dorcas. This species was found inhabiting many of the large puddles along the railroad corridor.

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EXECUTIVE SUMMARY

This report describes research to inventory the amphibians and reptiles inhabiting the railroad corridor between Gaffney and the W.S. Lee III Nuclear Station, Cherokee County, SC. In 2008 and 2009, we conducted manual surveys combined with trapping in aquatic habitats along and within close proximity to the proposed site for railroad construction. We documented a total of 33 species of amphibians and reptiles, including 11 species of anurans, 6 species of salamanders, 5 turtle species, 3 lizards, and 8 snakes. Two Species of Special Concern in South Carolina (Northern Cricket Frog, *Acris crepitans* and Pickerel Frog, *Rana palustris*) were both common to abundant. One farm pond that was adjacent to the railroad corridor contained several species of semi-aquatic turtles and a beaver pond at the point where the railroad site crosses London Creek contained numerous species of amphibians and reptiles. Overall, the species we documented during our survey at London Creek are typical for Piedmont habitat. No species were found that we thought unlikely to occur at London Creek and, given the available habitats, no species we expected to be able to easily find were absent. As development of the site proceeds, special consideration should be given to both minimizing disturbing streams and wetlands adjacent to the railroad as well as reducing mortality of animals documented frequenting the habitats that exist on the actual railroad bed proper.

INTRODUCTION

The biodiversity of Southeastern United States is immense and is reflected in the many species of amphibians and reptiles (herpetofauna) that inhabit this region. More than 450 species of amphibians and reptiles occur in the United States and approximately half occur in the Southeast (20% are endemic; Gibbons 1993, Palmer and Braswell 1995, Conant and Collins 1998). Amphibians and reptiles are an important part of ecosystems in nearly all southeastern habitats and make up especially important parts of aquatic ecosystems, including rivers, swamps, and wetlands (Gibbons et al. 2006). Because of their importance to proper ecosystem function, amphibians and reptiles can serve as useful indicators of the integrity of an ecosystem as well as providing information about the consequences of habitat destruction or other forms of environmental degradation (Gibbons 1988, Knutson et al. 1999, Vitt et al. 1990).

Although diverse and in many cases extremely abundant, amphibians and reptiles are for the most part clandestine species and thus, often overlooked components of southeastern ecosystems. Consequently, because of their cryptic nature combined with a lack of understanding of the importance of amphibians and reptiles, knowledge of the



An Atlantic coast slimy salamander (*Plethodon chlorobryonis*) can be easy to overlook due to its cryptic coloration.

herpetofaunal diversity and distribution in many areas of the Southeast is still lacking. For example, in South Carolina little documentation of the distribution of herpetofauna in South Carolina is available (Dorcas et al. 2006), except for intensive, long-term

surveys of a few areas (e.g., the Savannah River Site), Nevertheless, many areas are known to contain high herpetofaunal diversities and abundances. Investigating and documenting the species inhabiting areas of potential anthropogenic disturbance are important because such knowledge allows predictions of how anthropogenic alteration of habitats will affect amphibian and reptiles inhabiting the site of interest.

The proposed W.S. Lee III Nuclear Station (hereafter referred to as the Lee Nuclear Station) is operated by Duke Energy Carolinas LLC and is located in Cherokee County approximately 8 miles southeast of Gaffney, South Carolina. Development of this nuclear station will require construction

of a railroad from the town of Gaffney, SC to the site. Construction is expected to take place within an existing railroad corridor built in the 1970's. The purpose of this report is to provide information that will help to evaluate the potential impacts the



The former railroad corridor built in the 1960's. ATV's were utilized to traverse the 5.5 km of project area.

anthropogenic activities related to the construction of the railroad and related actions have on amphibians and reptiles inhabiting the property. Specifically, our objectives include:

1. Provide a list of amphibians and reptiles, with added emphasis on rare, threatened and endangered species, potentially occurring along the proposed railroad site between Gaffney and the W. S. Lee III Nuclear Station and its vicinity, Cherokee County, SC.

2. Survey the entire length of the proposed railroad (this includes the existing embankment and a 25-foot buffer extending out from the bottom of the berm of the rail embankment in both directions to determine habitats that warrant intensive sampling.
3. Document amphibian and reptile species inhabiting the proposed railroad site and adjacent areas (as described in #2 above) with special emphasis on any rare, threatened, or endangered species.
4. Estimate relative abundances of species and groups of species inhabiting the survey site.

METHODS

Study Site

The proposed Lee Nuclear Station is being planned by Duke Energy and is located within the Piedmont physiographic province of the Appalachian Mountain system. Duke Power Company conducted partial construction of the proposed Cherokee Nuclear Station on this site from 1977 to 1982. The railroad corridor which was a part of the Cherokee Nuclear Station construction and was previously studied is approximately 3.4 miles (5.5 km) in length and runs primarily ESE from the Ice Plant near Gaffney, SC to the Lee Nuclear Site through forested areas, areas of limited development, and areas actively undergoing logging (Fig. 1).

Potential Species Lists

A list of within-range species for the study area was generated based on geographic distribution maps published by Conant and Collins (1998), Petranka (1998),

and Lannoo (2005). Unfortunately, there are no publications or documents that provide detailed distribution records for amphibians and reptiles in South Carolina.

Consequently, we obtained all amphibian and reptile records for Cherokee County, South Carolina by querying 47 museums, universities, and other appropriate organizations (Appendix 1) to assist in developing a more accurate potential species list. Based on known geographic ranges and available habitat within or near the railroad corridor, we determined if each species potentially occurred within the study area.

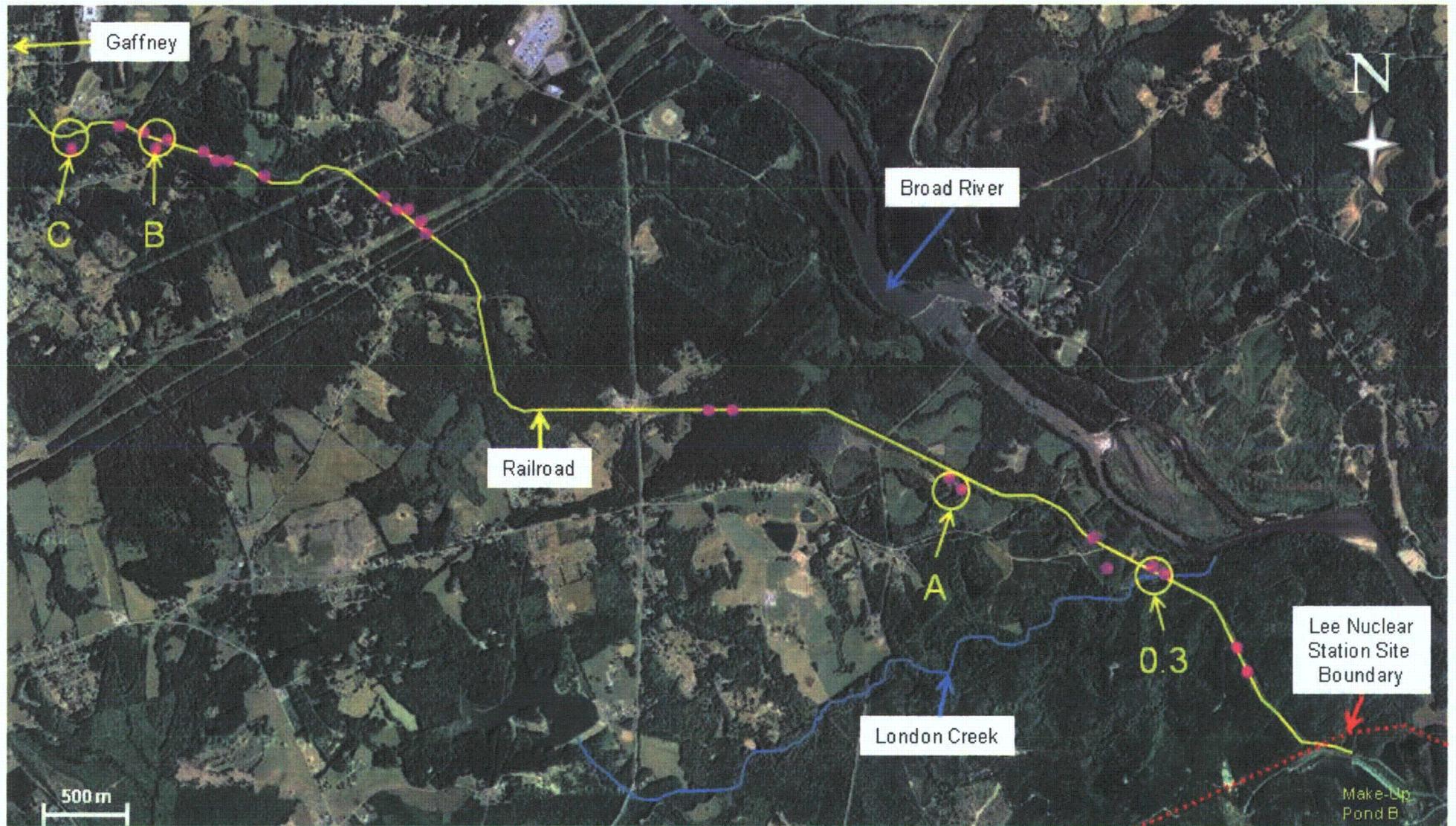


Figure 1. Map of the Lee Nuclear Station railroad with specific study sites circled and labeled. Pink dots represent all amphibian and/or reptile observations, keeping in mind that there can be several records for each dot. Note that study site 0.3 is where London Creek intersects with the railroad bed.

Sampling Methods

From February to July 2009, we periodically sampled habitats, both aquatic and terrestrial, using a variety of techniques (Table 1). We paid particular attention to wetland areas or areas where streams crossed the corridor, but also sampled selected forested habitats that appeared to be good habitat for amphibians and reptiles.

Table 1. Total sampling effort from February 2009 through July of 2009 for the Lee Nuclear Station railroad.

Month	Total Days	Total Person Days
Feb-09	1	4
Mar-09	0.5	5
Apr-09	0.5	4
May-09	0	0
Jun-09	1.5	15
Jul-09	0.5	4
Total Sampling Effort	4	32

One site (0.3) was sampled extensively during 2008 as part of a survey of the herpetofauna inhabiting London Creek (Fig. 1). We used minnow traps and turtle traps to sample amphibians and reptiles in addition to manual searching by turning cover objects and dipnetting in shallow water. Because of the intensive sampling conducted at site 0.3 during 2008, we did not conduct intensive sampling here during 2009 but focused our efforts on other habitats along the railroad corridor.

To sample the railroad corridor, we traversed the corridor using ATVs beginning at the Lee Nuclear Station and driving to the Ice Plant near Gaffney and back. While driving, we were able to make opportunistic observations of several species of amphibians and reptiles. One pond (Thompson's Pond; "A" on Fig. 1) adjacent to the

railroad corridor was sampled using turtle traps on two occasions. Two areas where hillside seeps were adjacent to the railroad (“B” and “C” on Fig. 1) were sampled intensively on several occasions for salamanders. Numerous large puddles in the railroad bed itself provided good habitat for a number of amphibians and reptiles, and thus, these areas were sampled on multiple occasions.

For each species encountered, we recorded the species name, sampling technique used, GPS coordinates (NAD 1983 UTM Zone 17N), number of individuals, and sampling location. Additionally, we recorded comments such as behavior, size, reproductive condition, etc. We recorded basic weather conditions for each day sampled. All data were entered into a database and incorporated into a GIS (ArcGIS



This Eastern kingsnake (*Lampropeltis getula*) is one of the many species encountered directly in the railroad corridor.

9.3 ERSI, Redlands, CA) to evaluate distributions in relation to geographic features. We considered species abundant if 8 or more observations were recorded, common if 3-7 observations were recorded, somewhat rare if the species was documented only twice and rare if only one observation was made. When possible, we documented all species using digital photography in order to allow for identification to species. For calling anurans, digital recordings were made on some occasions.

RESULTS AND DISCUSSION

Based on published distributions, 25 amphibian and 41 reptile species potentially occur along the railroad corridor (Table 2 and 3). We documented 33 species of amphibians and reptiles including 11 species of anurans, 6 species of salamanders, 5 species of turtles, 3 lizards, and 8 species of snakes (Fig. 2).

Table 2. List of potentially occurring and recorded amphibian species along the Lee Nuclear Station railroad. For details of which species were found at which locations, see electronic version of table.

Scientific Name	Common Name	Status
<i>Acris crepitans</i>	Northern cricket frog	Recorded*
<i>Bufo americanus</i>	American toad	Recorded
<i>Bufo fowleri</i>	Fowler's toad	Recorded
<i>Gastrophryne carolinensis</i>	Eastern narrowmouth toad	Recorded
<i>Hyla chrysoscelis</i>	Cope's gray treefrog	Recorded
<i>Hyla cinerea</i>	Green treefrog	Potential
<i>Hyla versicolor</i>	Gray treefrog	Potential
<i>Pseudacris crucifer</i>	Spring peeper	Recorded
<i>Pseudacris feriarum</i>	Upland chorus frog	Recorded
<i>Rana catesbeiana</i>	Bullfrog	Recorded
<i>Rana clamitans</i>	Green frog	Recorded
<i>Rana palustris</i>	Pickerel frog	Recorded*
<i>Rana sphenoccephala</i>	Southern leopard frog	Recorded
<i>Scaphiopus holbrookii</i>	Eastern spadefoot toad	Potential
<i>Ambystoma maculatum</i>	Spotted salamander	Potential
<i>Ambystoma opacum</i>	Marbled salamander	Recorded
<i>Desmognathus fuscus</i>	Northern dusky salamander	Recorded
<i>Eurycea cirrigera</i>	Southern two-lined salamander	Recorded
<i>Eurycea guttolineata</i>	Three-lined salamander	Potential
<i>Gyrinophilus porphyriticus</i>	Spring salamander	Potential
<i>Hemidactylium scutatum</i>	Four-toed salamander	Potential
<i>Notophthalmus viridescens</i>	Red spotted newt	Recorded
<i>Plethodon chlorobryonis</i>	Atlantic coast slimy salamander	Recorded
<i>Pseudotriton montanus</i>	Mud salamander	Potential
<i>Pseudotriton ruber</i>	Red salamander	Recorded

*Denotes a species of special concern in South Carolina.

Table 3. List of potentially occurring and recorded reptile species along the railroad. For details of which species were found at which locations, see electronic version of table.

Scientific Name	Common Name	Status
<i>Apalone spinifera</i>	Spiny softshell turtle	Potential
<i>Chelydra serpentina</i>	Common snapping turtle	Recorded
<i>Chrysemys picta</i>	Painted turtle	Recorded
<i>Kinosternon subrubrum</i>	Eastern mud turtle	Recorded
<i>Pseudemys concinna</i>	Eastern river cooter	Potential
<i>Sternotherus odoratus</i>	Common musk turtle	Potential
<i>Terrapene carolina</i>	Eastern box turtle	Recorded
<i>Trachemys scripta</i>	Yellow-bellied slider	Recorded
<i>Anolis carolinensis</i>	Green anole	Recorded
<i>Aspidoscelis sexlineatus</i>	Six-lined racerunner	Recorded
<i>Eumeces fasciatus</i>	Five-lined skink	Potential
<i>Eumeces inexpectatus</i>	Southeastern five-lined skink	Potential
<i>Eumeces laticeps</i>	Broadhead skink	Potential
<i>Ophisaurus attenuatus</i>	Slender glass lizard	Potential
<i>Sceloporus undulatus</i>	Fence lizard	Recorded
<i>Scincella lateralis</i>	Ground skink	Potential
<i>Agkistrodon contortrix</i>	Copperhead	Recorded
<i>Carphophis amoenus</i>	Worm snake	Recorded
<i>Cemophora coccinea</i>	Scarlet snake	Potential
<i>Coluber constrictor</i>	Black racer	Recorded
<i>Crotalus horridus</i>	Canebrake rattlesnake	Potential*
<i>Diadophis punctatus</i>	Ringneck snake	Recorded
<i>Elaphe guttata</i>	Corn snake	Potential
<i>Elaphe obsoleta</i>	Rat snake	Recorded
<i>Heterodon platirhinos</i>	Eastern hognose snake	Potential
<i>Lampropeltis calligaster</i>	Mole kingsnake	Potential
<i>Lampropeltis getula</i>	Eastern kingsnake	Recorded
<i>Lampropeltis triangulum</i>	Scarlet kingsnake-milksnake	Potential*
<i>Masticophis flagellum</i>	Coachwhip	Potential
<i>Nerodia sipedon</i>	Northern watersnake	Recorded
<i>Opheodrys aestivus</i>	Rough green snake	Potential
<i>Pituophis melanoleucus</i>	Pine snake	Potential*
<i>Regina septemvittata</i>	Queen snake	Potential
<i>Sistrurus miliarius</i>	Pigmy rattlesnake	Potential*
<i>Storeria dekayi</i>	Brown snake	Recorded
<i>Storeria occipitomaculata</i>	Redbelly snake	Potential
<i>Tantilla coronata</i>	Southeastern crowned snake	Potential
<i>Thamnophis sauritus</i>	Ribbon snake	Potential

<i>Thamnophis sirtalis</i>	Garter snake	Potential
<i>Virginia valeriae</i>	Smooth earth snake	Potential
<i>Virginia striatula</i>	Rough earth snake	Potential

***Denotes a species of special concern in South Carolina**

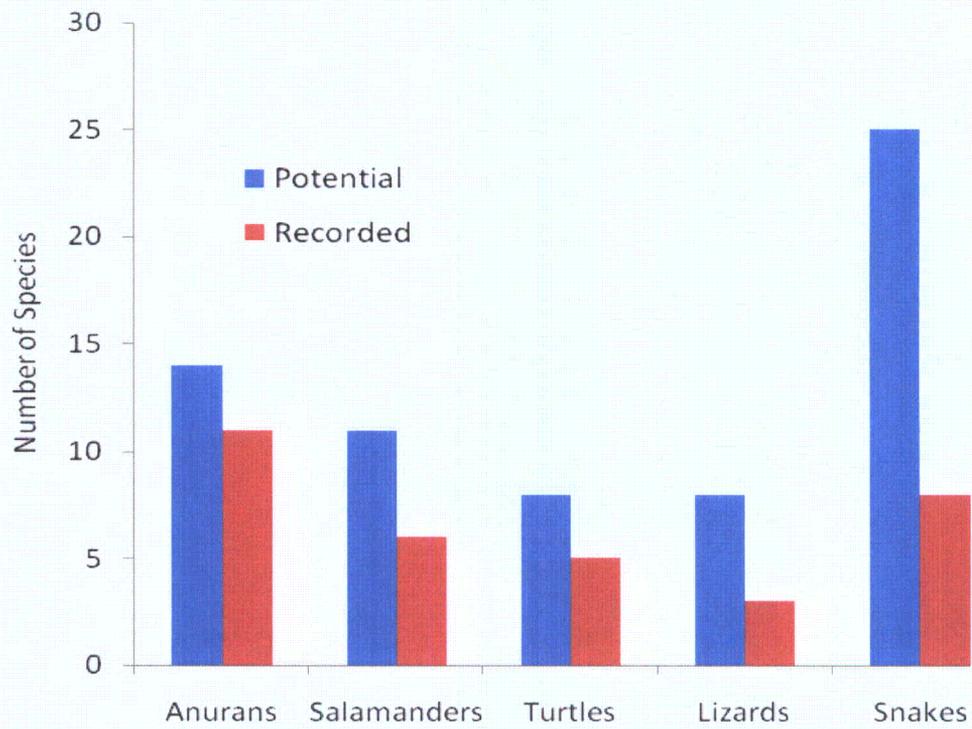


Figure 2. Number of potential and recorded species for herpetofaunal groups along the railroad.



The former railroad corridor intersects several diverse habitats used by many animal species, including several mammals, amphibians and reptiles.

Despite the fact that the railroad corridor is a relatively narrow, linear sampling area and there are limited wetland areas within and adjacent to it, we documented a relatively high number of species of amphibians and reptiles. This high diversity is likely

a combination of the fact that the corridor is essentially a large transect through a variety of habitat types, an early succession habitat, a route that provides relatively easy travel, and the high diversity of amphibians and reptiles inhabiting this region of Cherokee County. In addition to the wetlands at site 0.3, pond, and seeps (Fig. 1), we found that large puddles within the corridor provided important habitat for a number of amphibians (e.g., pickerel frogs, cricket frogs) and were also frequented by box turtles (*Terrapene carolina*). We found that the corridor itself appears to provide ideal habitat for box turtles. The relatively open area contains dense vegetation including species often consumed by box turtles and the large puddles in the corridor provide water and prey (e.g., amphibian larvae).

The site where London Creek passes under the corridor (site 0.3; Fig 1) provides particularly important wetland and stream habitats for a number of species of amphibians and reptiles. Numerous species of amphibians and reptiles were found at the



Because Site 0.3 was found to have a relatively high diversity of amphibians and reptiles, special consideration should be taken during construction to minimize impacts on animals and habitat.

beaver pond that was present during 2008 sampling. This beaver pond was washed out during heavy rains early in 2009 but it is likely that many of the species remain and as beavers rebuild in the area, a wetland suitable for the persistence of a diverse assemblage of amphibians and reptiles will likely be present.

Two amphibian and 4 reptile species occurred or potentially occurred along the Lee Nuclear Station railroad corridor that are considered Species of Special Concern by the state of South Carolina. Amphibians included the northern cricket frog (*Acris crepitans*) and the pickerel frog (*Rana palustris*). Reptiles included the timber/canebrake rattlesnake (*Crotalus horridus*), the milksnake (*Lampropeltis triangulum*), the pine snake



Large puddles on the railroad corridor were utilized by several species, such as the box turtle in this photo.

(*Pituophis melanoleucus*), and the pigmy rattlesnake (*Sistrurus miliarius*). We documented both amphibians but none of the four reptiles on the railroad corridor. We found northern cricket frogs to be abundant at numerous locations along the corridor (Table 4). The

open, muddy puddles formed in the railroad bed proper provided ideal habitat for this species (Dorcas and Gibbons 2008). Pickerel frogs were found at several locations along the railroad corridor as well (Table 4). Of the four reptiles considered of Special Concern in South Carolina, timber rattlesnakes are probably the species most likely to occur somewhere along the corridor. However, because of their secretive nature and lack of effective methods to target most snakes, they were not detected during our surveys.

Additionally, we focused our sampling on aquatic habitats reducing the likelihood of encountering many snake species.

Table 4. Qualitative relative abundances of amphibians and reptiles recorded along the Lee Nuclear Station railroad corridor.

Scientific Name	Common Name	Abundances
Anurans		
<i>Acris crepitans</i>	Northern cricket frog	Abundant
<i>Bufo americanus</i>	American toad	Somewhat Rare
<i>Bufo fowleri</i>	Fowler's toad	Common
<i>Gastrophryne carolinensis</i>	Eastern narrowmouth toad	Somewhat Rare
<i>Hyla chrysoscelis</i>	Cope's gray treefrog	Rare
<i>Pseudacris crucifer</i>	Spring peeper	Common
<i>Pseudacris feriarum</i>	Upland chorus frog	Somewhat Rare
<i>Rana catesbeiana</i>	Bullfrog	Abundant
<i>Rana clamitans</i>	Green frog	Abundant
<i>Rana palustris</i>	Pickerel frog	Common
<i>Rana sphenoccephala</i>	Southern leopard frog	Abundant
Salamanders		
<i>Ambystoma opacum</i>	Marbled salamander	Rare
<i>Desmognathus fuscus</i>	Northern dusky salamander	Abundant
<i>Eurycea cirrigera</i>	Southern two-lined salamander	Rare
<i>Notophthalmus viridescens</i>	Red spotted newt	Rare
<i>Plethodon chlorobryonis</i>	Atlantic coast slimy salamander	Somewhat Rare
<i>Pseudotriton ruber</i>	Red salamander	Rare
Turtles		
<i>Chelydra serpentina</i>	Common snapping turtle	Somewhat Rare
<i>Chrysemys picta</i>	Painted turtle	Somewhat Rare
<i>Kinosternon subrubrum</i>	Eastern mud turtle	Rare
<i>Terrapene carolina</i>	Eastern box turtle	Common
<i>Trachemys scripta</i>	Yellow-bellied slider	Somewhat Rare
Lizards		
<i>Anolis carolinensis</i>	Green anole	Common
<i>Aspidoscelis sexlineatus</i>	Six-lined racerunner	Common
<i>Sceloporus undulatus</i>	Fence lizard	Rare
Snakes		
<i>Agkistrodon contortrix</i>	Copperhead	Rare

<i>Carphophis amoenus</i>	Worm snake	Common
<i>Coluber constrictor</i>	Black racer	Common
<i>Diadophis punctatus</i>	Ringneck snake	Somewhat Rare
<i>Elaphe obsoleta</i>	Rat snake	Common
<i>Lampropeltis getula</i>	Eastern kingsnake	Rare
<i>Nerodia sipedon</i>	Northern watersnake	Rare
<i>Storeria dekayi</i>	Brown snake	Rare

Rare = 1 Observation

Somewhat Rare = 2 Observations

Common = 3-7 Observations

Abundant = 8 or more Observations

Although we did not focus heavily on sampling terrestrial environments, we did spend limited time surveying forested and open areas likely to harbor many species of terrestrial reptiles (e.g., lizards and snakes). We failed to find any five-lined skinks (*Eumeces fasciatus*) within or alongside the railroad corridor. This species is usually ubiquitous throughout the Piedmont of the eastern United States and is easily observed during warm weather. Failure to find five-lined skinks is perplexing (Rice et al. 2001).

Conclusions

We found the herpetofauna of the railroad corridor and its environs to be very similar to herpetofaunal found throughout the Piedmont of the Carolinas (Brown 1992; Rice et al. 2001). Like other areas within Cherokee County, we found a relatively high diversity of amphibians and reptiles. We did not find any species we thought unlikely to occur at the site and, other than five-lined skinks, we found no species absent that we expected to be able to easily find. The two South Carolina Species of Special Concern that were detected, northern cricket frogs and pickerel frogs were relatively abundant and found in a number of aquatic habitats.

During construction of the railroad, several considerations should be taken into account to reduce the impact on local herpetofauna. First, construction should be conducted so as to minimize impacts on wetlands and other aquatic habitats within and adjacent to the railroad corridor.

Special attention should be paid to make sure that impacts at site 0.3 are minimized to the extent possible because of the relatively high diversity of habitats and amphibian and reptile species found there.



Box turtles frequent the railroad corridor and care should be taken to minimize their mortality during the railroad construction.

Second, during construction of the railroad, careful attention

should be taken to ensure minimal mortality of box turtles inhabiting the corridor.

Construction of the railroad itself and roads to provide materials are highly likely to result in direct mortality of box turtles inhabiting the area. High rates of mortality in species that are long-lived, such as box turtles can severely threaten their populations (Congdon et al. 1994). Construction of the railroad should also include consideration of the impacts that an intact railroad can have on mortality and habitat fragmentation for box turtles.

Box turtles can become trapped between the rails of railroads and can succumb quickly to overheating or predation (Kornilev et al. 2006). Consideration should be given to providing a method for box turtles, and other turtle species, to either pass under or over railroad rails. Methods might include small tunnels between railroad ties that allow for turtles to crawl under the rails. Alternatively, small ramps on either side of each rail could be constructed that would allow turtles to pass over rails. Either approach would

likely require a modest amount of research to determine the most effective structure type and to determine exactly where such structures should be deployed.

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Appendix 1: Museums, universities, and other organizations from which geographic distribution records were requested for Cherokee County, South Carolina.

Academy of Natural Sciences
Arctos - UAM Herpetology Specimens
Auburn University Museum
Borror Laboratory of Bioacoustics
California Academy of Sciences
Carolina Herp Atlas
Carnegie Museum of Natural History
Chengdu Institute of Biology, Chinese Academy of Sciences
Cornell University Museum of Vertebrates
Field Museum
Florida Museum of Natural History
Georgia Museum of Natural History
Harvard University Provider
Illinois Natural History Survey
James R. Slater Museum
Los Angeles County Museum of Natural History
Michigan State University
Milwaukee Public Museum
Museum of Natural Science
Museum of Southwestern Biology at The University of New Mexico
Museum of Vertebrate Zoology
National Museum of Natural History, Smithsonian Institution
North Carolina State Museum of Natural Sciences
Online Zoological Collections of Australian Museums
Raffles Museum of Biodiversity Research
Royal Museum For Central Africa
Royal Ontario Museum
Sam Noble Oklahoma Museum of Natural History
San Diego Natural History Museum
Santa Barbara Museum of Natural History
Staatliches Museum für Naturkunde Stuttgart
Sternberg Museum of Natural History
Texas Cooperative Wildlife Collection
Universidad Nacional Autonoma de Mexico
University of Alabama, Alabama Museum of Natural History
University of Alberta
University of Arizona Museum of Natural History
University of Colorado Museum of Natural History
University of Kansas Biodiversity Research Center
University of Louisiana at Monroe
University of Nebraska State Museum
University of Nevada, Reno

University of Texas at El Paso
University of Texas-Austin
Utah Museum of Natural History
Yale University Peabody Museum
Zoological Institute RAS

Enclosure No. 1
Duke Letter Dated: November 2, 2009

Attachment 89S-3

HDR/DTA, 2009, *Avian Survey of the William S. Lee III Nuclear Station; Cherokee County, South Carolina*