

Enclosure No. 1
Duke Letter Dated: December 11, 2009

Attachment 89SB-1

Dorcas, M.E., 2009,

Herpetological Survey of London Creek, Cherokee County, South Carolina and Its Vicinity

*Herpetological Survey of London Creek,
Cherokee County, South Carolina and Its
Vicinity*

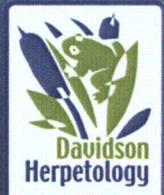


By Michael E. Dorcas

24 August 2009

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Purpose

This report details the efforts and results of field activities conducted during 2008 and 2009 to assess the status of amphibians and reptiles along London Creek, Cherokee County, SC and its vicinity and to comment on the possible impacts of the Make-up Pond C on the extant wildlife.

This report is a compilation of the herpetological field surveys conducted in both 2008 and 2009. The report summarizing only the 2008 studies (*Herpetological Survey of London Creek, Cherokee County, South Carolina and Its Vicinity* by Michael E. Dorcas-9 December 2008) remains a stand-alone document, but it was also completely assimilated into this report in order to have both years of data in the same report.

Suggested Citation

Dorcas, M. E. 2009. Herpetological survey of London Creek, Cherokee County, South Carolina and its vicinity. Final Report to Duke Power Company.

Cover Photograph

Southern Two-lined Salamander (*Eurycea cirrigera*) photographed at Location 2.6 on London Creek, South Carolina by M. E. Dorcas, April 2008.

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Cherokee County, South Carolina and its
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TABLE OF CONTENTS

Executive Summary	5
Introduction	6
Methods	9
Results and Discussion	16
Acknowledgements	30
Literature Cited	31
Appendix 1	34
Ancillary Materials (available on CD from Duke Energy)	
Master database of all specimens	
Voucher photographs	
Expanded versions of Tables	

EXECUTIVE SUMMARY

This report describes research to inventory the amphibians and reptiles inhabiting London Creek and its vicinity, Cherokee County, South Carolina conducted during 2008 and 2009. A list of 66 species of amphibians and reptiles potentially occurring in and around London Creek was generated using known distributional ranges and museum records. A variety of field techniques were used to document the occurrence of 41 species of amphibians and reptiles, including 12 species of anurans, 8 salamanders, 7 turtles, 5 lizards, and 9 snakes. In 2008, surveys were conducted only within London Creek proper and on the south side of London Creek because of property restrictions. In 2009, we had access to most of property on the north side of London Creek as well and conducted surveys of wetlands and farm ponds within the London Creek watershed, in addition to surveying portions of London Creek inaccessible to us in 2008. Overall, habitats surveyed included London Creek and its floodplain, wetlands, upland habitats, and numerous farm ponds within the London Creek watershed. Two species were found (northern cricket frog, *Acris crepitans* and the pickerel frog, *Rana palustris*) that are considered Species of Concern by the state of South Carolina. Overall, the species documented during our study at London Creek and its vicinity are typical for Piedmont habitat. We did not find any species we thought unlikely to occur in the area and no species we expected to be able to easily find were absent.

INTRODUCTION

The diversity of amphibians and reptiles (herpetofauna) in the Southeast is unparalleled in other parts of the United States. More than 450 species 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 the native biodiversity in nearly all southeastern habitats. Therefore, the status of herpetofauna can be used as an indicator of the integrity of a habitat as well as the consequences of habitat destruction or other forms of environmental degradation (Gibbons 1988, Knutson et al. 1999, Vitt et al. 1990).

Although sometimes unseen, amphibians and reptiles can be extremely abundant, and are thus important components of southeastern ecosystems.

They are important as both predators and prey (Burton and Likens 1975, Gibbons and Dorcas 2004, Taylor et al. 1988), and thus represent critical trophic links in many ecosystems. Also,



Amphibians and their eggs serve as prey for many species of other amphibians and reptiles.

because amphibians and reptiles are ectothermic with high energy conversion efficiencies, the biomass of many populations can greatly exceed that of birds and mammals (Burton and Likens 1975, Congdon and Gibbons 1989, Godley 1980, Iverson 1982, Petranka and Murray 2001). Therefore, the amphibians and reptiles of an area can collectively serve as indicators of environmental integrity (Gibbons et al. 2000); hence, comprehensive accounts of regional species composition and diversity are fundamental to initiating effective monitoring or research programs applicable to conservation issues.

Inventories at prescribed locations for particular taxonomic groups are vital to assessment of an area's ecological integrity and are essential for future mitigation.



Pickerel frog (*Rana palustris*).

Unfortunately, knowledge of the herpetofaunal diversity and distribution in many areas of the Southeast is still lacking. One such region is the majority of the state of South Carolina. Except for intensive,

long-term surveys of a few areas (e.g., the Savannah River Site), little documentation of the distribution of herpetofauna in South Carolina is available (Dorcas et al. 2006).

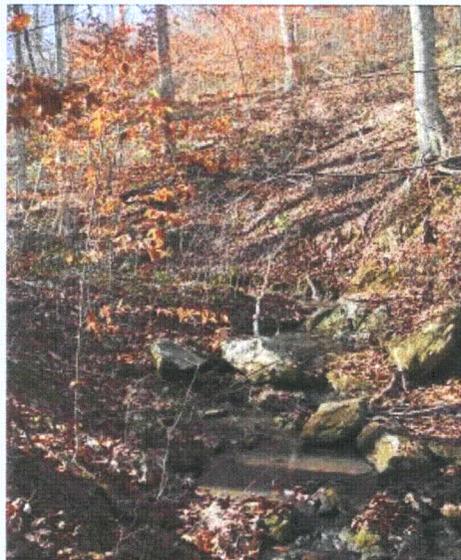
Nevertheless, many areas are likely to harbor high herpetofaunal diversities and abundances. One such area includes London Creek in east-central Cherokee County, SC.

London Creek, with a watershed of 3.88 sq. mi. (1005 ha) is a small, second-order stream whose headwaters are Lake Cherokee, a 45 ac (18.2 ha) impoundment owned by the SC Department of Natural Resources (Fig 1). The majority of the water in London Creek, with the exception of the small, intermittent, un-named streams/seeps that flow



Figure 1. Aerial image indicating the location of Lake Cherokee, the Broad River and Lee Nuclear Station.

into London Creek, is provided by over-the-dam spillage from Lake Cherokee. London Creek flows 5.3 km (3.3 mi) in a northeasterly direction and enters the upper end of Ninety-Nine Islands Reservoir; a Duke Energy Corporation run-of-the-river impoundment on the Broad River.



Typical terrain at London Creek.

A mixed hardwood and pine plantation forest covers the majority of the London Creek valley interspersed with pastureland and some upslope farmsteads/residences. Within the pastureland, several farm ponds have been constructed that provide aquatic habitats for amphibians and reptiles. As mentioned earlier, London Creek's flow is largely dependent on Lake Cherokee [0.2 mi² (0.5 km²) watershed; average depth 11 ft. (3.4 m)]. Considering the small watershed of Lake Cherokee, coupled with the seasonal flows of the small tributaries entering London Creek, London Creek's flow in low-rainfall seasons like spring and summer 2008 resulted in extended periods where London Creek was essentially dry with only a series of small, shallow, isolated, pools.



Drying tributaries leave isolated, shallow pools.

Biological (fish, aquatic macroinvertebrate, avian, mammalian, and amphibian/reptile) and botanical investigations were designed and carried out during 2008 and 2009. The purpose of this array of studies was to characterize the flora and fauna of selected areas of the London Creek valley where ingress was

authorized. In this study, we used extensive field surveys to document the diversity of amphibians and reptiles in the London Creek area.

Specific Objectives

1. Provide a list of amphibians and reptiles potentially occurring at London Creek, its vicinity, and the zone of operational influence.
2. Document the amphibian and reptile species inhabiting London Creek and vicinity, including any rare, threatened, or endangered species.
3. Qualitatively estimate relative abundances of species and groups of species in London Creek and vicinity.

METHODS

Study Locations

London Creek is situated east of Gaffney, SC in Cherokee County (Fig. 2). The London Creek valley is being considered as a potential location for a new water supply reservoir (Make-Up Pond C) for the Lee Nuclear Station. Specific sampling locations were established along the creek (Fig. 3) and surveys were done in a wide area around



ATVs facilitated access to all sampling locations along London Creek.

these specific locations. In addition to these designated sampling locations (Fig. 4) along London Creek some wetlands and a series of farm ponds within pasturelands in the London Creek watershed and one, Bob's Pond, within a forested area closer to London Creek (Fig 5),

were also sampled. All sampling locations represented sections of the creek accessible through land easements/agreements and were specifically selected because of potentially available habitat for herpetofauna. Location 0.3 contained a beaver pond which provided

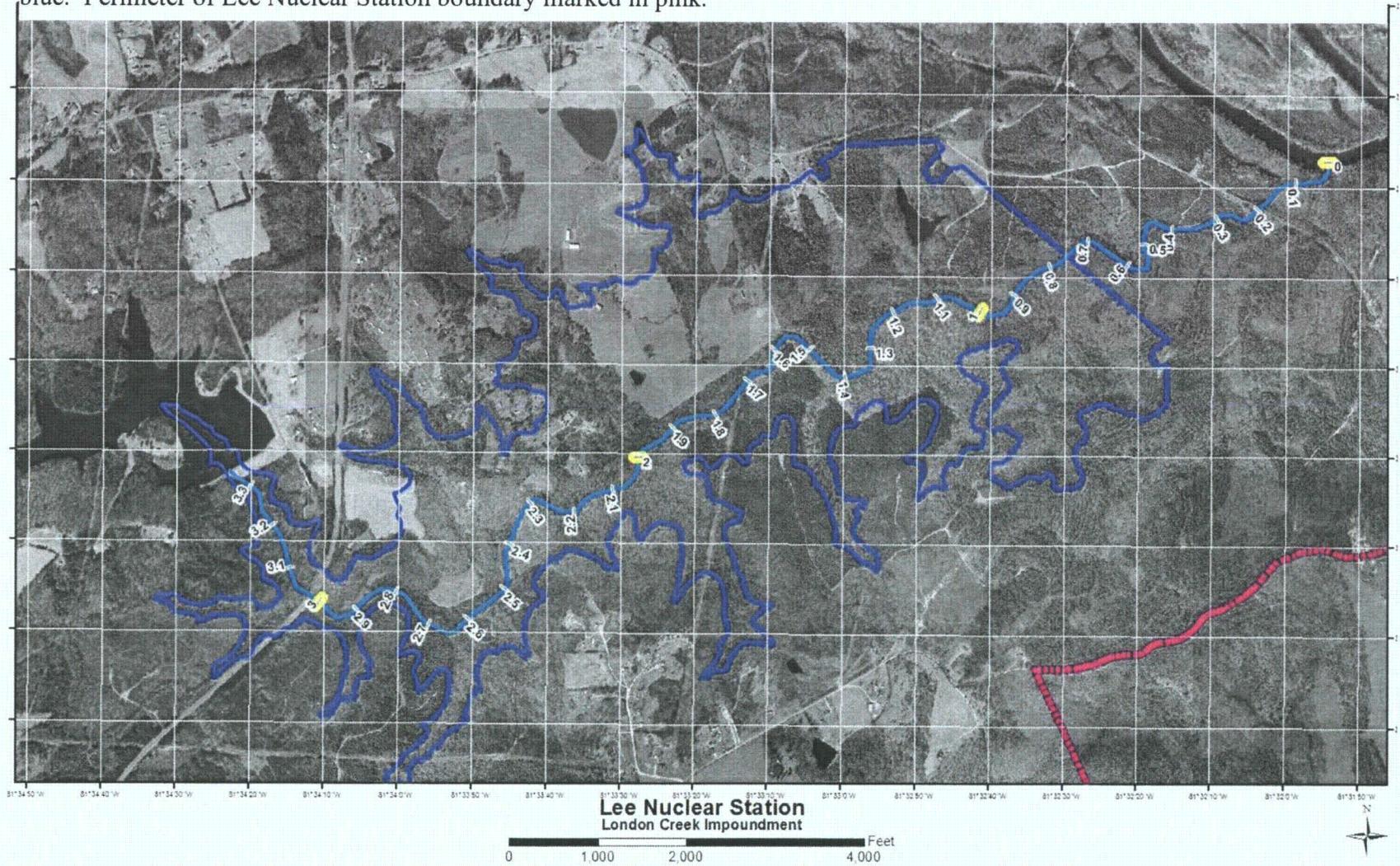
considerable wetland habitat for numerous species of amphibians and reptiles. Location 0.9 was comprised of a typical section of Piedmont stream with some slower moving and some riffle-type areas. Location 1.7 contained a wide variety of stream and floodplain habitat. Several deep areas of the stream were interspersed with shallower rocky areas with faster water flows. Several ephemeral wetlands were present within the floodplain of the stream at this location. Location 2.6 encompassed three first-order streams that flowed into London Creek.

In 2008, surveys were conducted only within London Creek proper and on the south side of London Creek because of property restrictions. In 2009, we were provided access to most of property on the north side of London Creek as well and focused our surveys on wetlands and farm ponds within the London Creek watershed on the north side of London Creek. In 2009, we also surveyed some areas of London Creek proper and its watershed, specifically areas upstream of Hwy 329 and between the future site of the dam for Makeup Pond C to Location 1.7.



Figure 2. Map of South Carolina counties. London Creek location indicated within Cherokee County which is highlighted in green.

Figure 3. An aerial map of London Creek with sampling locations indicated in yellow. Proposed reservoir boundary is marked in blue. Perimeter of Lee Nuclear Station boundary marked in pink.



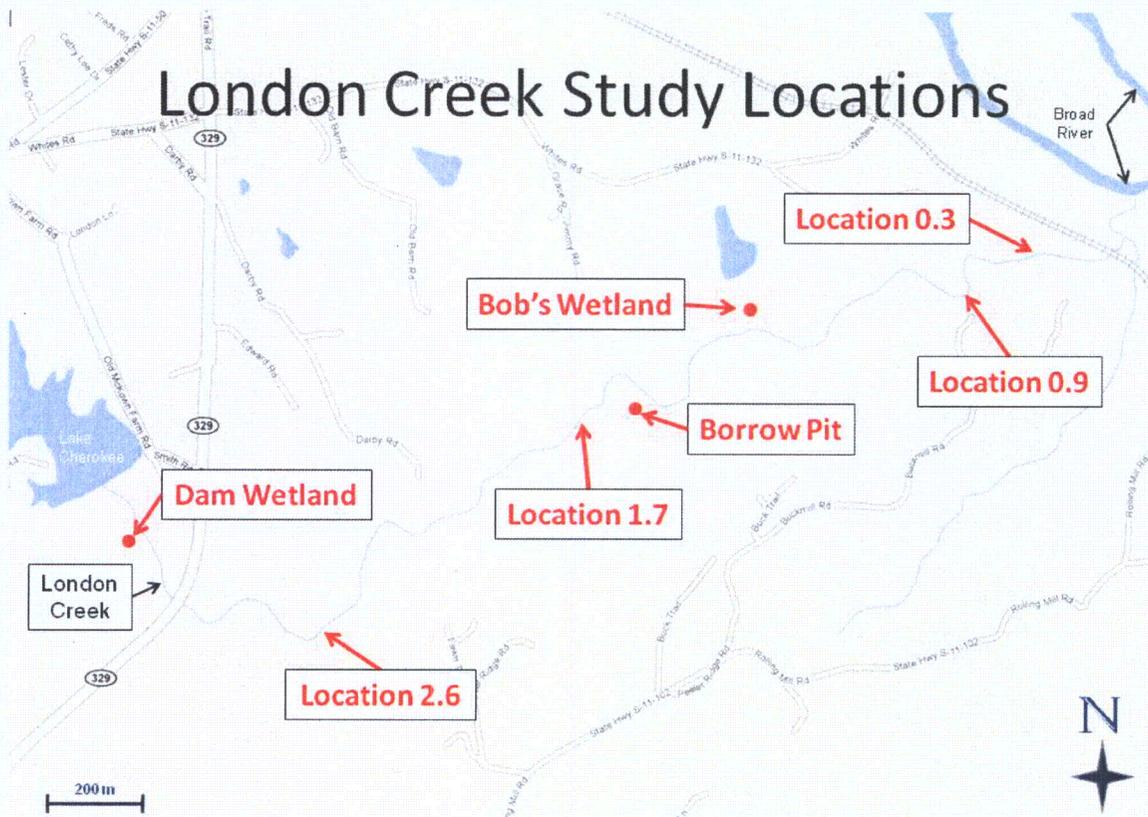


Figure 4. Map indicating the primary study locations used in our study at London Creek.

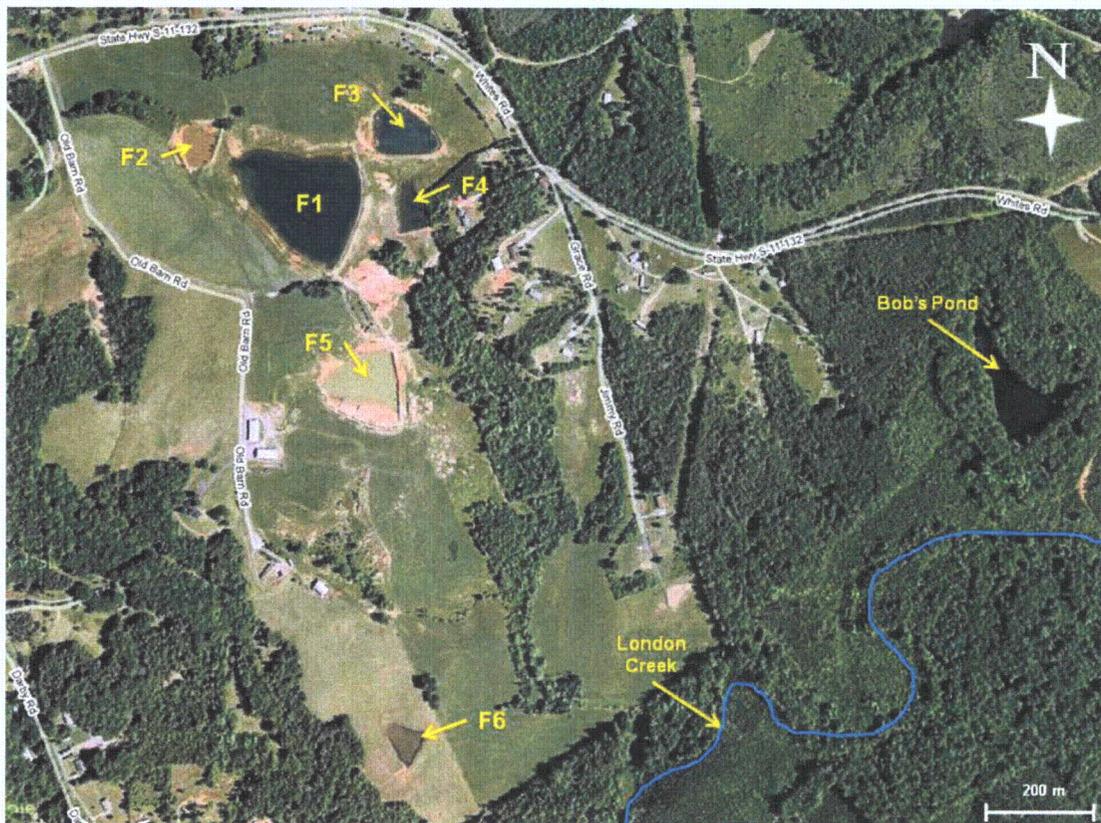


Figure 5. Map indicating locations of farm ponds in the pastureland adjacent to London Creek as well as Bob's Pond in the forested area close to the creek.

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). Because the habitats of London Creek proper (i.e., London Creek and its watershed) and the area on the north side of London Creek (e.g., farm ponds) are quite different, we developed potential species lists separately for London Creek proper and the London Creek site farm ponds. 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 habitat available within the study location, we categorized each unrecorded species as either potentially occurring within London Creek proper or the London Creek ponds.

Sampling Methods

We sampled 1 day in January 2008 to establish sampling locations and from 1 to 10 days per month from March through October 2008 and 1 to 4 days per month from February through July 2009 to survey for herpetofauna (Table 1) at London Creek proper. Very limited sampling was conducted during July and August when summer temperatures cause many amphibians and reptiles to become inactive and thus difficult to find. During 2009, our sampling also included 7 farm ponds found within the pastureland in the London Creek site.

Table 1. Total sampling effort from January 2008 through July of 2009 for London Creek amphibian and reptile surveys.

Month	Total Days	Total Person Days
Jan-08	1	5
Mar-08	5	9
Apr-08	3	8
May-08	3	11
Jun-08	10	19
Jul-08	2	2
Sep-08	2	4
Oct-08	1	4
Feb-09	1	5
Mar-09	1	10
Apr-09	0.5	4
May-09	0	0
Jun-09	4	19
Jul-09	0.5	4
Total Sampling Effort	34	104

We conducted intensive sampling at the designated sampling locations in London Creek Proper (Fig. 4), but also recorded species as we traveled between locations. We used an array of sampling techniques ranging from automated recording systems (Peterson and Dorcas 1994, Bridges and Dorcas 2000), systematic dipnetting, minnow traps, and turtle traps baited with sardines. We also extensively sampled the study area using general herpetological collecting techniques including turning over cover objects, systematic searching in favorable habitats, and anuran calling surveys. As a part of the London Creek mammalian study that was conducted simultaneously with this herpetofaunal study, pitfall traps (3.8 liter metal cans buried with lips flush with the ground) were deployed in suitable habitat at locations 0.3, 1.7, and 2.6. Herpetofauna captured during this sampling was included in our results.

Sampling at the 7 farm ponds during 2009 consisted of using hoop traps baited with sardines to sample each available pond for turtles. Traps were set at each farm pond



Microphone directed towards area suitable for breeding frogs and toads

Recorder, battery, and timer circuit in protective case

Automated recording systems were used for sampling frogs and toads at London Creek. Such systems use a timer system to periodically record animal calls and can be used to monitor calling animals when investigators cannot be present.

with the number of traps per pond ranging from 2 – 6, depending on the size of the pond and potential turtle habitat available. We also conducted a nighttime calling survey for anurans at these ponds during late June, 2009.

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 9.3 ERSI, Redlands, CA) to evaluate distributions in relation to geographic features. We considered



Common snapping turtle (*Chelydra serpentina*) juvenile. Photo taken at Location 2.6.

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 when possible. For some species (anuran tadpoles, salamander larvae) we collected a limited number of voucher specimens. All voucher specimens were deposited in the North Carolina Museum of Natural Sciences.

RESULTS AND DISCUSSION

Based on published distributions, other documents, and specimen records, we determined that 14 anurans, 11 salamanders, 8 turtles, 8 lizards, and 25 species of snakes potentially occurred in the entire study area (Fig. 6; Tables 2 and 3).

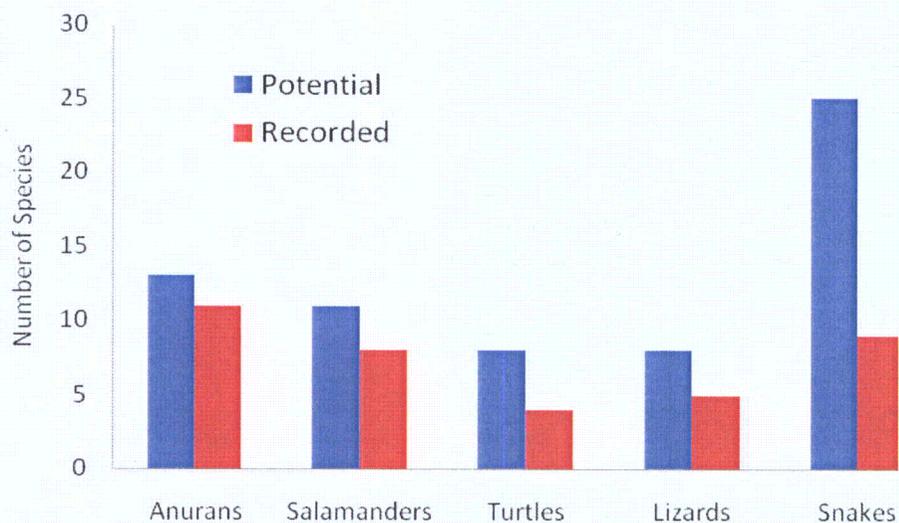


Figure 6. Number of potential and recorded species for herpetofaunal groups at London Creek and its vicinity.

London Creek

We documented 11 species of anurans, 8 salamanders, 4 turtles, 5 lizards, and 9 snake species at London Creek study sites (Tables 2 and 3; Fig. 6). Overall, our documented species list reflected a typical herpetofauna for Piedmont habitat found along London Creek (Rice et al. 2001; Dorcas et al. 2006). A map representing all recorded herpetofaunal localities is presented in Fig. 8 (page 29).

Table 2. List of potentially occurring and recorded amphibian species at London Creek study sites. For details of which species were found at which locations, see electronic version of table.

<i>Scientific Name</i>	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	Recorded
<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	Recorded
<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 at London Creek and its vicinity. For details of which species were found at which sampling 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	Potential
<i>Kinosternon subrubrum</i>	Eastern mud turtle	Recorded
<i>Pseudemys concinna</i>	Eastern river cooter	Recorded
<i>Sternotherus odoratus</i>	Common musk turtle	Potential
<i>Terrapene carolina</i>	Eastern box turtle	Recorded
<i>Trachemys scripta</i>	Yellow-bellied slider	Potential
<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	Recorded
<i>Ophisaurus attenuatus</i>	Slender glass lizard	Potential
<i>Sceloporus undulatus</i>	Fence lizard	Recorded
<i>Scincella lateralis</i>	Ground skink	Recorded
<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	Recorded
<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**

Our literature searches and regulatory agency contacts revealed that 2 amphibian and 4 reptile species occurred or potentially occurred within the study area that are



Northern cricket frog (*Acris crepitans*).

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 (*Pituophis melanoleucus*), and the pigmy rattlesnake (*Sistrurus miliarius*). We documented two of these six species.

We found northern cricket frogs to be abundant at all main sampling locations. This species is generally found along open, muddy or rocky areas of the stream. Pickerel frogs were found at three locations (Locations 1.7, 2.6 and Bob's Wetland). It is possible, or even likely, that timber rattlesnakes also occur within the study area, but were not detected during our surveys.

Several notable species were found that are not assigned status by any regulatory agency but that are either locally rare, difficult to find, and/or restricted to specific habitats. Marbled salamanders (*Ambystoma opacum*) and spotted salamanders (*A. maculatum*) were both found during our surveys. Both of these species typically rely on

ephemeral wetlands, habitats that are disappearing from much of the southeastern United States, for reproduction (Petranka 1998). Marbled salamander larvae were found at 4 locations (Locations 0.3 [2008], 1.7 [2009], 2.6 [2008], and Bob's Wetland [2009]), one adult was found at Location 1.7 and another adult at Bob's Wetland. The distinctive egg mass of a spotted salamander was found in February 2008 in a slow moving part of London Creek. Numerous egg masses were also found at a borrow pit wetland in 2009 at site 1.7 and at Bob's Wetland (Fig 4). In 2008, we also found a river cooter (*Pseudemys concinna*), which are typically found in large rivers or lakes and not in small streams basking on a log at Location 1.7 (which is 1.7 miles from the confluence of London Creek with the Broad River). We attempted to capture this animal to determine its health status, but were unsuccessful.



Rare sighting of an river cooter (*Pseudemys concinna*) basking at London Creek.

During our surveys, we failed to document several potentially occurring species that we expected to find based on geographic range and habitat. We did not find any five-lined skinks (*Eumeces fasciatus*). 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). We did not find any queen snakes (*Regina septemvittata*), although apparently suitable stream habitat was present at most of the sampling locations and throughout the study area and crayfish, their preferred food, were prevalent throughout all aquatic areas (Gibbons and Dorcas 2004). This species has been difficult to detect in other regions of the Piedmont as well and populations may have declined in

some areas (Rice et al. 2001; Dorcas 2004). Some of the other snake species potentially occurring in the study area such as corn snakes (*Elaphe guttata*) and green snakes (*Opheodrys aestivus*) likely inhabit in the area, but these species may occur in such low numbers and/or are so



Marbled salamander (*Ambystoma opacum*).

secretive that detection is difficult. We did not find redbelly snakes (*Storeria occipitomaculata*) or earth snakes (*Virginia* sp.). These small, secretive, fossorial species likely occur in the area but were just not detected.

Our sampling regime was designed to document as many species of amphibians and reptiles as possible, and thus, not intended to estimate relative or absolute abundances. However, based on our extensive surveys, we were able to comment somewhat qualitatively on the numbers of individual amphibians and reptiles encountered and make qualified statements regarding the abundances of each within the study area (Table 4). In general, species requiring stream habitat [e.g., Dusky salamanders (*Desmognathus fuscus*)] were extremely abundant throughout the study area in suitable areas. Some species that typically require isolated wetlands (e.g., marbled salamanders) for breeding were relatively abundant within the study area.

Table 4. Qualitative relative abundances of amphibians and reptiles recorded in the London Creek vicinity.

Scientific Name	Common Name	Abundance
Anurans		
<i>Acris crepitans</i>	Northern cricket frog	Abundant
<i>Bufo americanus</i>	American toad	Common
<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	Abundant

<i>Pseudacris crucifer</i>	Spring peeper	Common
<i>Pseudacris feriarum</i>	Upland chorus frog	Abundant
<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 maculatum</i>	Spotted salamander	Common
<i>Ambystoma opacum</i>	Marbled salamander	Abundant
<i>Desmognathus fuscus</i>	Northern dusky salamander	Abundant
<i>Eurycea cirrigera</i>	Southern two-lined salamander	Abundant
<i>Gyrinophilus porphyriticus</i>	Spring salamander	Somewhat Rare
<i>Notophthalmus viridescens</i>	Red spotted newt	Common
<i>Plethodon chlorobryonis</i>	Atlantic coast slimy salamander	Abundant
<i>Pseudotriton ruber</i>	Red salamander	Rare

Turtles

<i>Chelydra serpentina</i>	Common snapping turtle	Rare
<i>Kinosternon subrubrum</i>	Eastern mud turtle	Somewhat Rare
<i>Pseudemys concinna</i>	Eastern river cooter	Rare
<i>Terrapene carolina</i>	Eastern box turtle	Common

Lizards

<i>Anolis carolinensis</i>	Green anole	Abundant
<i>Aspidoscelis sexlineatus</i>	Six-lined racerunner	Common
<i>Eumeces laticeps</i>	Broadhead skink	Rare
<i>Sceloporus undulatus</i>	Fence lizard	Common
<i>Scincella lateralis</i>	Ground skink	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	Common
<i>Elaphe obsoleta</i>	Rat snake	Common
<i>Lampropeltis getula</i>	Eastern kingsnake	Somewhat Rare
<i>Nerodia sipedon</i>	Northern watersnake	Common
<i>Storeria dekayi</i>	Brown snake	Rare
<i>Thamnophis sirtalis</i>	Garter snake	Rare

Rare = 1 Observation

Somewhat Rare = 2 Observations

Common = 3-7 Observations

Abundant = 8 or more Observations

*Although rarely seen in this study, copperheads were commonly seen during nocturnal bat surveys.

London Creek Ponds

Sampling at the farm ponds during 2009 revealed a diverse turtle fauna (Fig. 7; Table 6). All species expected to be present were found in at least one farm pond and several species (e.g., painted turtles [*Chrysemys picta*] and yellowbelly sliders [*Trachemys scripta*]) were found at several ponds. Bob's Pond had an exceptionally diverse turtle assemblage that included snapping turtles, mud turtles, common musk turtles, and sliders. Curiously, no painted turtles were found at Bob's pond. Densities of turtles varied substantially among the ponds, but ponds F2, F5, and Bob's Pond had the highest numbers of turtles captured (Table 8). However, when the area of the pond is considered, the smallest pond (F2) had the highest density of turtles. Anuran calling surveys conducted during one night at the farm ponds in the upper pastureland (i.e., ponds F1-F5) revealed several species of summer breeding anurans and a species composition expected for such habitat and season including green treefrogs (*Hyla cinerea*) at most ponds and the northern cricket frog (*Acris crepitans*), a Species of Special Concern in South Carolina (Fig. 7; Table 5). It is likely that other species of anurans that typically breed in the winter or early spring also occur at these farm ponds, including the pickerel frog, a Species of Special Concern in South Carolina. However, sampling at the ponds was limited to late spring and summer.

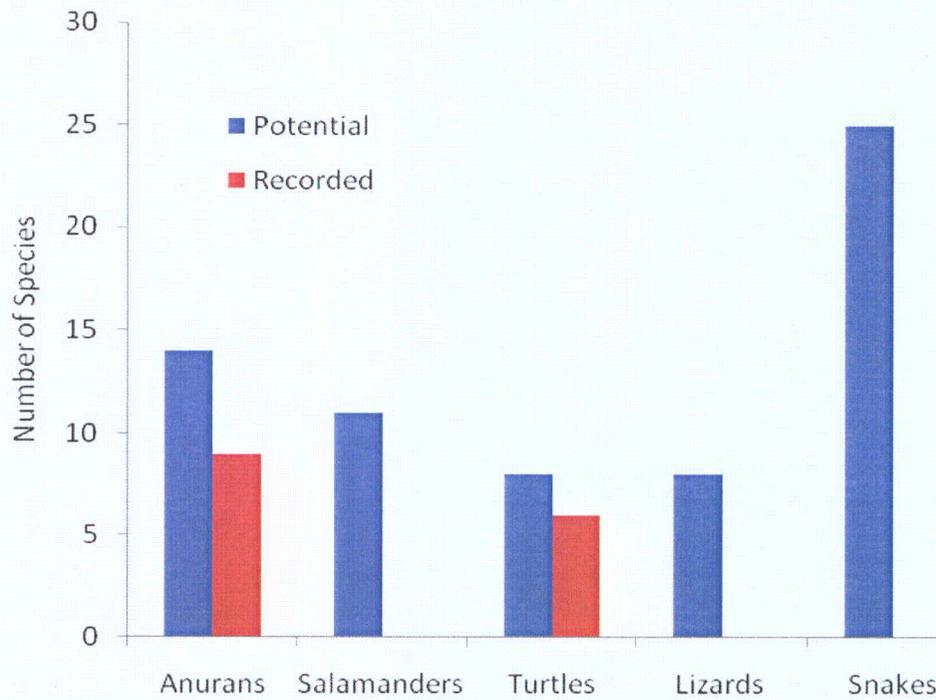


Figure 7. Number of potential and recorded species for herpetofaunal groups at London Creek farm ponds.

Table 5. List of potentially occurring and recorded amphibian species at London Creek farm ponds. 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	Recorded
<i>Hyla versicolor</i>	Gray treefrog	Potential
<i>Pseudacris crucifer</i>	Spring peeper	Potential
<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	Potential*
<i>Rana sphenoccephala</i>	Southern leopard frog	Potential
<i>Scaphiopus holbrookii</i>	Eastern spadefoot toad	Potential
<i>Ambystoma maculatum</i>	Spotted salamander	Potential
<i>Ambystoma opacum</i>	Marbled salamander	Potential
<i>Desmognathus fuscus</i>	Northern dusky salamander	Potential

<i>Eurycea cirrigera</i>	Southern two-lined salamander	Potential
<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	Potential
<i>Plethodon chlorobryonis</i>	Atlantic coast slimy salamander	Potential
<i>Pseudotriton montanus</i>	Mud salamander	Potential
<i>Pseudotriton ruber</i>	Red salamander	Potential

*Denotes a species of special concern in South Carolina.

Table 6. List of potentially occurring and recorded reptile species at London Creek farm ponds. 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	Recorded
<i>Terrapene carolina</i>	Eastern box turtle	Recorded
<i>Trachemys scripta</i>	Yellow-bellied slider	Recorded
<i>Anolis carolinensis</i>	Green anole	Potential
<i>Aspidoscelis sexlineatus</i>	Six-lined racerunner	Potential
<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	Potential
<i>Scincella lateralis</i>	Ground skink	Potential
<i>Agkistrodon contortrix</i>	Copperhead	Potential
<i>Carphophis amoenus</i>	Worm snake	Potential
<i>Cemophora coccinea</i>	Scarlet snake	Potential
<i>Coluber constrictor</i>	Black racer	Potential
<i>Crotalus horridus</i>	Canebrake rattlesnake	Potential*
<i>Diadophis punctatus</i>	Ringneck snake	Potential
<i>Elaphe guttata</i>	Corn snake	Potential
<i>Elaphe obsoleta</i>	Rat snake	Potential
<i>Heterodon platirhinos</i>	Eastern hognose snake	Potential
<i>Lampropeltis calligaster</i>	Mole kingsnake	Potential
<i>Lampropeltis getula</i>	Eastern kingsnake	Potential
<i>Lampropeltis triangulum</i>	Scarlet kingsnake-milksnake	Potential*
<i>Masticophis flagellum</i>	Coachwhip	Potential

<i>Nerodia sipedon</i>	Northern watersnake	Potential
<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	Potential
<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.

Table 7. Qualitative relative abundances of amphibians and reptiles recorded in London Creek and vicinity.

Scientific Name	Common Name	Abundances
Anurans		
<i>Acris crepitans</i>	Northern cricket frog	Abundant
<i>Bufo americanus</i>	American toad	Rare
<i>Bufo fowleri</i>	Fowler's toad	Abundant
<i>Gastrophryne carolinensis</i>	Eastern narrowmouth toad	Rare
<i>Hyla chrysoscelis</i>	Cope's gray treefrog	Somewhat Rare
<i>Hyla cinerea</i>	Green treefrog	Abundant
<i>Pseudacris feriarum</i>	Upland chorus frog	Rare
<i>Rana catesbeiana</i>	Bullfrog	Somewhat Rare
<i>Rana clamitans</i>	Green frog	Rare
Turtles		
<i>Chelydra serpentina</i>	Common snapping turtle	Common
<i>Chrysemys picta</i>	Painted turtle	Abundant
<i>Kinosternon subrubrum</i>	Eastern mud turtle	Common
<i>Sternotherus odoratus</i>	Common musk turtle	Rare
<i>Terrapene carolina</i>	Eastern box turtle	Rare
<i>Trachemys scripta</i>	Yellow-bellied slider	Abundant

Rare = 1 Observation

Somewhat Rare = 2 Observations

Common = 3-7 Observations

Abundant = 8 or more Observations

Table 8. Overall turtle abundances at the London Creek site farm ponds (all species combined). A trap day equals the number of traps multiplied by the number of days that trap was deployed. Pond ID's correspond to ponds labeled in Figure 5.

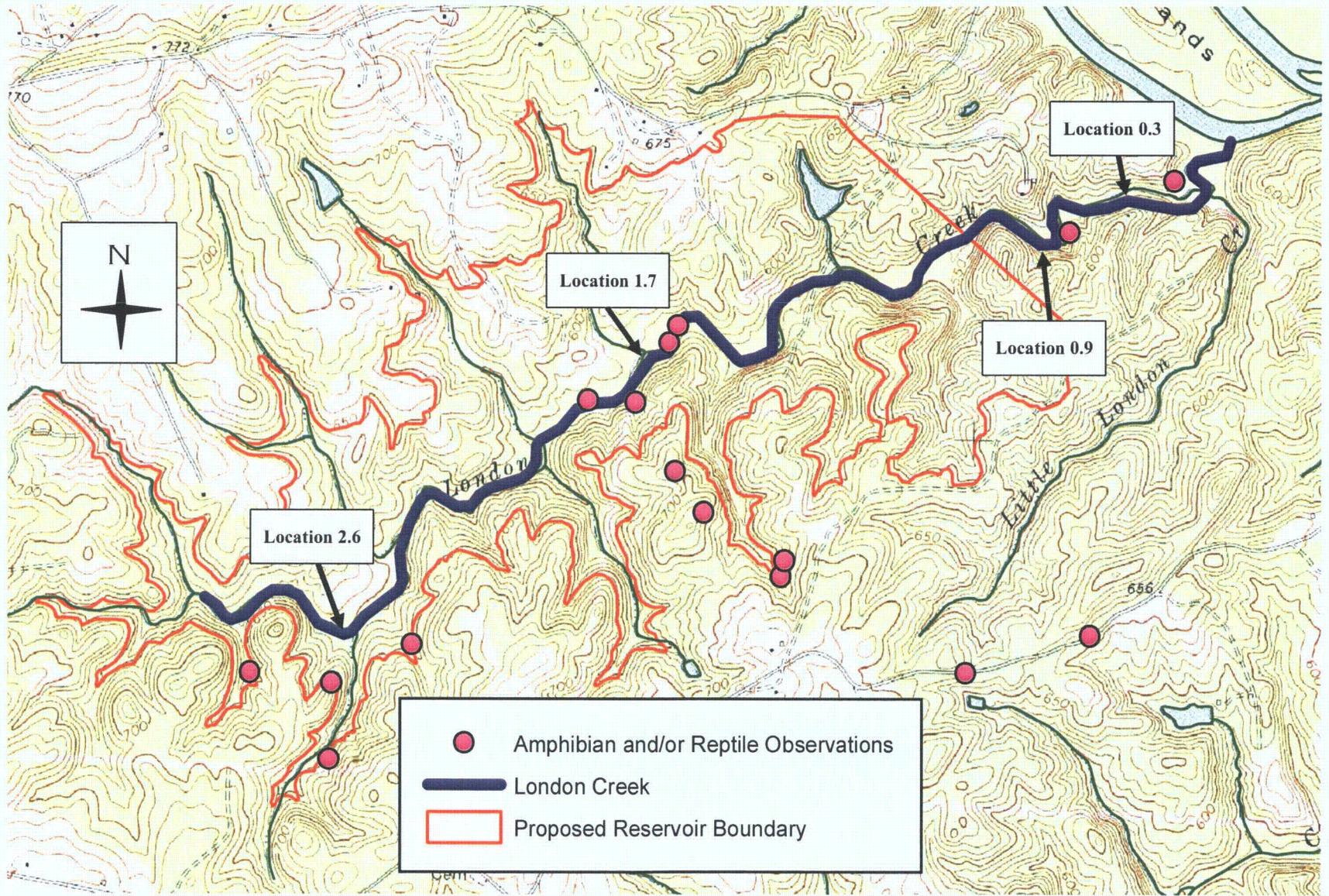
Pond ID	F1	F2	F3	F4	F5	F6	Bob's Pond
# Trap Days	24	4	12	16	8	8	28
# Turtles	12	6	6	8	12	4	31
Pond Acreage (ha)	6.37 (2.58)	0.63 (0.25)	1.72 (0.70)	0.80 (0.32)	1.97 (0.80)	0.74 (0.30)	3.11 (1.26)
Turtles/Trap Day	0.50	1.50	0.50	0.50	1.50	0.50	1.10
Turtles per Trap Day/ac (ha)	0.08 (0.19)	2.38 (6.00)	0.29 (0.71)	0.63 (1.56)	0.76 (1.88)	0.68 (1.67)	0.35 (0.87)

Conclusions

Based on the results of our survey, we found the herpetofaunal of London Creek and its environs to be very similar to herpetofauna found throughout the Piedmont of the Carolinas. We did not find any species we thought unlikely to occur at London Creek and no species we expected to be able to easily find were absent. Like most of the Piedmont of South Carolina, the number of herpetofaunal species considered rare, threatened, or endangered is relatively low. Other investigators have found comparable diversity (Brown 1992; Rice et al. 2001). Primary aquatic habitats within the Piedmont are typically stream-based ecosystems often with associated farm ponds, beaver ponds and floodplain wetlands. When such diverse habitats occur in close proximity with vast tracts of intact forest, they can result in diverse herpetofaunal assemblage such as that at London Creek (Metts et al. 2001; Willson and Dorcas 2004). The presence of amphibians dependent on ephemeral pools and wetlands (i.e., marbled and spotted salamanders, [*Ambystoma* sp.]) at multiple sites indicates suitable breeding habitat for these species exists throughout the area. The diversity and abundance of turtles in the

farm ponds within the London Creek watershed is typical of Piedmont habitats. If these ponds are to be drained, consideration should be given to moving turtles to nearby suitable habitats. Anthropogenic impacts (e.g., logging, lay down yards, reservoir construction) will detrimentally affect wetland, stream, and pond ecosystems and the uplands surrounding them resulting in decreased numbers and diversity of amphibians and reptiles.

Figure 8. Locations where amphibians and reptiles were recorded at London Creek. Note that at many locations, multiple species were found resulting in many overlapping locations.



ACKNOWLEDGEMENTS

Gene Vaughan, Mark Auten, Steven Price, Glenn Long, Adrien Domske, Lynea Witzak, Andy Whorton, Rick Bauer, Jordan Roberts, Zachary Dorcas, Lauren Seay, Amber Lassiter, and James Hall all assisted with field work in the study area. Tim Leonard provided many of the GIS files used in the project. Gene Vaughan provided valuable logistical assistance and guidance for nearly every aspect of this project. Numerous curators, collection managers, and others provided assistance in obtaining records of amphibians and reptiles occurring in the study area. Steven Price provided considerable assistance with the GIS and proofread the final report. Adrien Domske helped maintain the database, generated all figures and tables for the report, and greatly assisted with overall production of the report. Photographs were taken by Adrien Domske and Mark Auten. Funding for this project was provided by Duke Energy Corporation. All collecting was done under permit issued by the South Carolina Department of Natural Resources to MED through the University of Georgia's Savannah River Ecology Laboratory.

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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