

**Inventory of Amphibians and Reptiles
of Stones River National Battlefield**



November 2005

ON THE COVER

An amplexed pair of Southern Leopard Frogs (*Rana sphenoccephala utricularia*) in Stones River National Battlefield

Photograph by Matthew L. Niemiller

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INTRODUCTION

Stones River National Battlefield (STRI) is located at the nw corner of Murfreesboro in Middle Tennessee. STRI commemorates the Battle of Stones River and is actively managed by the National Park Service as a historic park. Although the Battle of Stones River occurred on nearly 4000 acres, STRI comprises only 647.39 acres of mixed hardwood forests, cedar thickets, limestone cedar glades, old fields, and agricultural fields. Because a rapidly growing community surrounds the park, STRI potentially serves as a refuge for flora and fauna representative of dwindling middle Tennessee native ecosystems. The purpose of this study was 1) to inventory the reptile and amphibian species that occur at STRI; and 2) to estimate the distribution and relative abundance of documented species.

SITE DESCRIPTION

Stones River National Battlefield is located in Rutherford County, Tennessee, approximately 48 km se of Nashville. STRI lies within the Inner Central Basin (ICB) ecoregion of the Interior Low Plateau Physiographic Province (Fenneman 1938, Griffith et al. 1997). The ICB is characterized by low relief; elevations seldom exceed 200 m. The soils and vegetative features of the ICB and STRI have been described elsewhere (Hogan and Webber 1999, Kuchler 1964, Springer and Elder 1980). Permanent and intermittent streams of the ICB have a low to moderate gradient and often have a rock-rubble or limestone bedrock substrate (Etnier and Starnes 1993). The current authorized boundary of STRI encompasses 647.39 acres (288 ha) and consists of six separate and isolated units (National Park Service 1998). The six units include the Main Battlefield Park (MB), the Artillery Monument (AM), Fortress Rosecrans (FR), Redoubt Brannan (RB), and the headquarter sites for General Bragg and General Rosecrans.

The MB encompasses 205 ha and is the largest of the isolated units. With the exception of the Stones River National Cemetery and three agricultural fields that are actively planted and harvested, the MB is wooded and undeveloped. Upland hardwood forests dominate the wooded areas. The forest type is represented by dry to mesic oak and oak-hickory forests and oak-dominated forests with a strong Eastern Redcedar (*Juniperus virginia*) component (Hogan and Webber 1999). Approximately 24 ha of cedar glades and barrens are also found at the MB (National Park Service 1998). The glades are openings in stands of Eastern Redcedar where the soil over the Ridley Limestone is very shallow, precluding permanent invasions by trees (National Park Service 1998). Old-field communities dominate some areas and are primarily composed of weedy herbaceous vegetation with scattered woody species (Hogan and Webber 1999). An assortment of rock outcroppings, sinkholes, and sinkhole caves also dot the landscape.

The AM lies east of U.S. HWY 41 and includes a portion of the West Fork of the Stones River. This unit encompasses 65 ha of STRI and is composed largely of open-field habitats. Other habitats found at this unit include floodplain forests, such as those found along the Stones River and The Nature Conservancy tract, that are dominated by Hackberry (*Celtis* spp.), Green Ash (*Fraxinus pennsylvanica*), Boxelder (*Acer negundo*), Sycamore (*Platanus occidentalis*), and Cottonwood (*Populus deltoides*) (Hogan and Webber 1999). This unit also hosts a permanent pond community known as King Pond. A large population of Common Duckweed (*Limna minor*) dominates the open water of this pond (Hogan and Webber 1999). The pond attracts an assortment of wildlife, such as the White-tailed Deer (*Odocoileus virginianicus*) and several species of birds. Also, two agricultural fields are present at the AM.

The FR unit lies on 10 ha and supports the remnants of the original earthworks of Lunette Palmer, Curtain Wall no. 2, and Lunette Thomas. These earthworks are actively managed for native warm season grasses, such as Broomsedge (*Andropogon* spp.) and Indian Grass (*Sorghastrum nutans*). This site also contains a 0.965 km interpretive trail that encircles the earthworks. At FR, Lytle Creek flows into an impoundment that overflows into the West Fork of the Stones River. The wooded rock outcroppings host mixed hardwood species, such as Oak (*Quercus* spp.), Ash (*Fraxinus* spp.), Hackberry (*Celtis* spp.), and Elm (*Ulmus* spp.), as well as exotic shrub species, such as Chinese Privet (*Ligustrum sinense*) and Bush Honeysuckle (*Lonicera maackii*).

The 2.2 ha RB unit also contains earthworks and an interpretive trail. Below the earthworks, a floodplain forest is adjacent to the West Fork of the Stones River. Rock outcroppings and small rock bluffs are characteristic of the upland area. A small pond is located near the floodplain forest.

General Bragg's and General Rosecran's headquarters units encompass 2.8 and 0.16 ha, respectively. These areas are well groomed and maintained as lawn by the park staff and, therefore, were not included in this inventory.

METHODS

Expected Species List

A list of species expected to occur at STRI was compiled from historical and current distributional records and published range maps (Conant and Collins 1991, Redmond and Scott 1996). All species reported to occur in Rutherford County, Tennessee were included on the Expected List, which consisted of 12 species of frogs, 15 species of salamanders, seven species of lizards, 17 species of snakes, and eight species of turtles. (Appendix A).

Sampling Techniques

Several collecting techniques were used to inventory the herpetofauna. Coverboards were placed at predetermined, but randomly chosen, circular, 1-ha plots. The number and location of the plots was established by the NPS, in conjunction with NatureServe, as part of the STRI vegetation mapping/plant inventory project. Other survey methods included general field techniques historically practiced by herpetologists and considered the most efficient way for experienced collectors to find the largest number of species in the least amount of time (McDiarmid and Donnelly 1994). The collecting techniques included lifting rocks, logs, and debris in terrestrial and stream-side or pond-side habitats, the use of dip nets and seines, minnow traps, crab traps, and hoop traps (Legler 1960) in aquatic habitats, slowly driving roads at night (=road cruising; Klauber 1939, Saugey and Trauth 1991, Shaffer and Juterbock 1994), aural surveys for calling frogs, and installation of drift fencing in association with funnel box-traps or pit-fall traps.

Coverboard Arrays. Within most 1-ha plots, four coverboards were arranged in a systematic cluster. Two coverboards were placed flush with a line running through each plot center. The northwest corner of one of these boards was placed flush with the east side of the line at 10 m north of the center point. The se corner of the other board was placed flush with the west side of the line at 10 m south of the center point. Two boards were placed flush with a second line that ran perpendicular to the north running line (190° - 270°). The ne corner of one of these boards was placed flush with the south side of the line at 10 meters east of the plot center. The sw corner of the other board was placed flush with the north side of the line at 10 m west of the center point. At each plot, two of the boards were wooden (4'x4' x 1/2" plywood) and the other two were tin (4'x3' corrugated).

Some modification had to be made to the placement of coverboard arrays at several of the predetermined sites. The following coverboard sites were not used. 1) The array south of Stones River National Cemetery occurred in a leased agricultural field. 2) An array at Redoubt Brannan occurred in a floodplain. 3-4) Two arrays at Fortress Rosecrans occurred in areas of high visitor contact. 5) The array adjacent to the Stones River in the Nature Conservancy tract occurred in a floodplain. Other modifications in coverboard array placement included the following. A) The array near the woodline at the Chicago Board of Trade site (Tour Stop 4) was shifted 10 meters west to prevent its placement in an active agriculture field at the site. B) The northern board in the array located west of the tour loop (before Tour Stop 3) was shifted 24 meters north to avoid disturbing a cedar glade community. C) The array near King Pond at the Artillery Monument was shifted 324° for 24 meters to avoid the pond and fencing. D) The array east of the Michigan Marker occurred on a limestone outcropping and was shifted to a more suitable habitat 200 meters north of the predetermined site. All coverboards were placed on 18 April 2003. Following a month acclimation period, the coverboard arrays were checked weekly. As per NPS protocol, area-constrained searches were conducted at coverboard sites that were omitted.

Drift fencing and funnel box-traps. Two drift-fence and funnel box-trap systems were installed during May 2003. These systems consisted of a funnel box trap constructed of plywood and ¼” hardware cloth. The traps had plywood tops and bottoms and hardware cloth sides. Inverted funnels of hardware cloth were installed on each side. After placement of the trap, 100 feet of drift-fencing was installed in three directions from the trap. One trap system was placed at the border of an old field and forest in the Artillery Monument. A second system was placed in a similar habitat in the Main Battlefield Park. The traps were checked once daily while set.

Drift-fencing-pitfall traps. These traps were placed around King Pond in the Artillery Monument during January 2004. This system consisted of 450 feet of drift-fencing that encircled the pond. Seventeen pitfall traps consisting of either 2.5 or 5.0 gal buckets were placed flush with ground level on both the inside and outside of the drift fence. The pitfalls were checked at least once daily while open.

Aural Surveys. Surveys of anuran vocalizations were made at several sites.

Visual Encounter Surveys. This method was used frequently during the survey. Survey sites were visually searched for amphibian and reptile species.

Road survey. This method was limited to the Main Battlefield Park and Artillery Monument sites. A tour loop road, 2.2 miles in length, exists at the Main Battlefield Park and an entrance road occurs at the Artillery Monument. These roads were searched while driving to and from collecting sites and when environmental conditions were optimal, such as during evening rainstorms. Observations of all amphibians or reptiles encountered, whether living or dead, were recorded.

Minnow traps. Unbaited minnow traps were set in shallow water with ca 10 cm of the trap exposed to air. Minnow traps were set during the spring of 2003.

Aquatic turtle trap surveys. Hoop and crab nets were used to sample aquatic turtles at King Pond, Redoubt Brannan Pond, and the at Lytle Creek impoundment at Redoubt Brannan. Hoop traps were baited with chicken livers or necks and checked within 24-36 hours after placement. Crab nets were used in the same locations as the hoop traps when the water was clear. The nets were pulled to shore when a turtle was seen foraging on the bait.

Measurements

All amphibians and reptiles captured were measured to the nearest mm with calipers, plastic rulers, meter sticks, or metric tapes. The mass, to the nearest gram, was determined for each animal captured with Pesola scales or laboratory balances. The Total Length (TL) of frogs was measured from the tip of the snout to the posterior tip of the cloaca. TL was measured in salamanders with complete tails from the tip of the snout to the tip of the tail. Snout to Vent Length (SVL) of salamanders was measured from the snout tip to the posterior tip of the cloaca. SVL of lizards was taken from the tip of the snout to the posterior margin of the anal plate, and total length was measured in individuals with complete tails from the snout tip to the tip of the tail. The SVL of snakes was measured from the snout tip to the posterior margin of the anal plate; TL from snout tip to tail tip. A string was used to facilitate measuring larger snakes. A straight-line carapace length was measured in turtles. Age (larva, juvenile, adult) was recorded for each amphibian and reptile captured. Sex was recorded for all adult individuals.

Locational Data

The location where each amphibian or reptile was captured or observed was recorded. Latitude and longitude coordinates were determined with hand-held or backpack GPS units.

Voucher Specimens

Digital photographs (Appendix C) were used to voucher the amphibian and reptile species found at STRI.

RESULTS

During the inventory period, 810 observations of individual amphibians or reptiles and 27 breeding choruses of frogs were recorded at STRI. From these observations, seven species of frogs (58% of expected), four species salamanders (27% of expected), four species of lizards (57% of expected), eight species of snakes (47% of expected), and six species of turtles (75% of expected) were identified (Table 1). Although fifty-nine species of amphibians and reptiles have distributions that include Rutherford County and potentially occur at STRI, only 29 (49%) were confirmed as inhabitants of the park. No species listed as Rare, Threatened, or Endangered by the Tennessee Wildlife Resources Agency or by the United States Fish and Wildlife Service were observed.

The Bullfrog (*Rana catesbeiana*) was the most abundant amphibian species found at STRI (Table 1). This species accounted for 78% of all frog observations and 70% of all amphibian observations. Most of these observations were made in the Artillery Monument, in the vicinity of the Stones River and King Pond. The Southern Leopard Frog (*R. sphenocephala*) was the second most abundant species of amphibian found. This species accounted for 10% of all frog observations. This species was most commonly encountered at the Artillery Monument in the vicinity of King Pond. Eastern Spadefoots (*Scaphiopus holbrookii*) were found breeding only in the Main Battlefield Park, in a low-lying field subject to seasonal flooding (Lake Garesche). The Narrow-mouth Toad (*Gastrophryne carolinensis*) has a similarly restricted distribution at STRI and was found breeding only in a flooded field near the corner of Lunette Thomas at Fortress Rosecrans. However, an adult was found beneath a rock in the cedar glade habitat at the Main Battlefield Park. Narrow-mouth toads presumably breed in at least one of the ephemeral wetlands associated with the glades.

The salamander fauna known to occur in Rutherford County was not well represented at STRI. The Zigzag Salamander (*Plethodon dorsalis*) was the most commonly encountered salamander species, and was most abundant in the cedar glades and woodlands associated with the Main Battlefield Park (Table 1). Very few observations of other salamanders were made, with only one observation each for the Tiger Salamander (*Ambystoma tigrinum*) and the Cave Salamander (*Eurycea lucifuga*), and only two for the Eastern Newt (*Nothophthalmus viridescens*).

The Eastern Fence Lizard (*Sceloporus undulatus*) accounted for 50% of all lizard observations and was the most abundant species of lizard observed at STRI (Table 1). The Five-lined Skink (*Eumeces fasciatus*) and the Broad-headed Skink (*E. laticeps*) were also encountered fairly commonly (Table 1). Only one observation of the Ground Skink (*Scincella lateralis*) was recorded (Table 1).

The Eastern Racer (*Coluber constrictor*) was the most commonly encountered snake species in the terrestrial habitat and the only species observed in each of the isolated units of STRI inventoried (Table 1). The Eastern Garter Snake (*Thamnophis sirtalis*) was most abundant in the Artillery Monument, in the vicinity of King Pond (Table 2); whereas, the Queen Snake (*Regina septemvittata*) and the Northern Watersnake (*Nerodia sipedon*) were associated largely with the Stones River riparian zone. The Common Kingsnake (*Lampropeltis getula*) was found in three of the four isolated units. In contrast, the Milksnake (*L. triangulum*) was found only in the Main Battlefield Park (Table 1). None of the relatively small fossorial snake species known to occur in Rutherford County were observed at STRI.

Turtles were the best-represented herpetofaunal taxon at STRI (Table 1). Five of the six species observed are aquatic and most observations were recorded in the Stones River or

associated sloughs. The Red-eared Slider (*Trachemys scripta elegans*) was the most abundant reptile species (Table 1). This species accounted for 58% of all turtle observations and 40% of all reptile observations. The Stinkpot (*Sternotherus odoratus*) was the second most commonly encountered reptile species (Table 1), and accounted for 28% of all turtle observations.

Relatively fewer observations of the Common Snapping Turtle (*Chelydra serpentina*), Map Turtle (*Graptemys geographica*) and Eastern Spiny SoftShell (*Apalone spinifera*) were made (Table 1). The Eastern Box Turtle (*Terrepenne carolina*) was the only turtle species to be observed in each of the isolated units of STRI (Table 1).

Species Composition of the Isolated Units

The composition of the herpetofaunal community varied among the four isolated units at STRI inventoried (Table 1). Twenty species were documented at the Main Battlefield Park, 20 species at Artillery Monument, 17 species at Fortress Rosecrans, and 13 species at Redoubt Brannan. The difference in composition was associated with size and habitat diversity of the separate units (Table 2).

Comparative Effectiveness of Survey Techniques

The effectiveness of the survey techniques varied by site, habitat, and species (Table 2, Table 3). Breeding choruses were heard of each of the seven frog species found at STRI. In comparison, five species were found during Visual Encounter Surveys (VES), no species were found under coverboards (CB), two species in association with drift fence trapping, and two with minnow traps (MT). No frogs were found during road surveys.

The VES was the most effective sampling technique for salamanders. All salamander species identified and nearly all individuals observed were found with VES (Table 3).

The VES and drift fence trapping techniques were equally effective in sampling species of lizards (Table 3). Only the Ground Skink (*Scincella lateralis*) was not detected by these methods (Table 3).

The VES and CB were most effective at sampling snake species (Table 3). Seven of the eight species found were located during VES, and five species were found via CB. One species was sampled with drift-fence trapping, and one was captured in a minnow trap.

Each of the seven species of turtles identified at STRI was found with VES (Table 3). Also, each of the six aquatic species identified were trapped with either the turtle crab traps (TT) or turtle hoop traps (Table 3). The TT was labor intensive, but was responsible for the collection of most individuals.

DISCUSSION

Many species found throughout much of Middle Tennessee, including Rutherford County, and in habitats present at STRI, were not found during this investigation. The relatively low ratio of documented species to expected species could be the result of an unrealistic expected species list coupled with extirpation of species associated with historic land use practices, such as agriculture, that eliminated suitable habitat. For example, we included all species known to occur in Rutherford County, Tennessee in the expected species list. However, several of these species have specific habitat requirements that do not occur, or are poorly represented, at STRI. As a case in point, 15 species of salamanders have distributions that include Rutherford County, Tennessee, but only four species were observed at STRI. In retrospect, several salamander species with limited distributions in Rutherford County or with specific habitat requirements should not have been included on the expected list. For example, although the Mud Salamander (*Pseudotriton montanus*) and the Dusky Salamander

(*Desmognathus fuscus*) have been reported from ne Rutherford County (Redmond and Scott 1996), the former species is associated with lowland springs and adjacent forested areas (Martof 1975) and the latter species with flowing, generally fish-free streams. Similar to the situation with the Dusky Salamander, the Longtailed Salamander (*Eurycea longicauda*) and the Southern Two-lined Salamander (*E. cirrigera*) generally inhabit clear, fish-free spring-fed streams (Petrank 1998). Also, four species of ambystomatid salamanders occur in Rutherford County, Tennessee (Redmond and Scott 1996, Scott et al. 1997). Three of these four species typically breed in ephemeral, fish-free bodies of water (*Ambystoma tigrinum*, *A. opacum*, *A. maculatum*). The length of time that the ephemeral wetlands are flooded at STRI is not of sufficient duration to allow for egg and larval development of any of these species. The Tiger Salamander observed at STRI presumably wandered onto the site from neighboring property. The Streamside Salamander (*A. barbouri*) breeds in first or second order streams (Petranka 1998), and extant populations of this species are known in Tennessee from only a few sites in Rutherford County, each a few km south of STRI (Regeister and Miller 2000, Miller and Niemiller, unpubl.), but breeding habitat is not present at STRI. Suitable habitat is present for the remaining four species of salamanders on the expected list, but not observed during the inventory period. The Eastern Hellbender (*Cryptobranchus alleganiensis*) and the Mudpuppy (*Necturus maculosus*) inhabit the Stones River in Rutherford County (Miller and Miller 2005; pers. obs.) and, therefore, could be located in the section of this river that flows through STRI. Similarly, the Tennessee Cave Salamander (*Gyrinophilus palleucus*) inhabits subterranean waters of Snail Shell Cave in Rutherford County. The stream in Snail Shell Cave discharges into the Stones River within a few km of STRI. Dye analysis indicates that the subterranean water system of Rebel Yell Cave, located in the Main Battlefield Park, is confluent with Snail Shell Cave (pers. com., Allen

Ogden, Geology Department, MTSU). Because of this association, the Tennessee Cave Salamander could be in the subterranean waters of STRI.

The lizard species found at STRI are those species common within middle Tennessee (Jordan et al. 1968, Miller et al. 2005). Three expected species were not detected. The Six-lined Racerunner (*Cnemidophorus sexlineatus*) is a common and ubiquitous inhabitant of many of the glade habitats with the Central Basin of middle Tennessee (pers. obs.). The Southeastern Five-lined Skink (*Eumeces inexpectatus*) has a patchy distribution in the Central Basin of middle Tennessee. The Eastern Slender Glass Lizard (*Ophisaurus attenuatus attenuatus*) is associated with grasslands and cutover areas. However, it is a secretive and fossorial species and, therefore, rarely encountered.

The documentation of snake species at STRI was skewed toward the larger-bodied species that are often found active on the surface. The complete absence of records for the smaller, more fossorial snakes is surprising. Although several of these fossorial species are not commonly encountered (e.g., *Cemophora coccinea*, *Tantilla coronata*, *Storeria occipitomaculata*), particularly in the shallow soils characteristic of the Central Basin (pers. obs.), a couple species are very common and easy to locate (e.g. *Diadophis punctatus*, *Carphophis amoenus*), particularly during a VES.

The turtle species of STRI are those common within middle Tennessee in general and in Rutherford County specifically. Although Conant and Collins (1991) indicate that the range of the Painted Turtle (*Chrysemys picta*) includes middle Tennessee, museum records are lacking and this species had not been reported by others studying turtle communities in Rutherford County (Limsuwan and Dunn 1978, Varner 1995). The Eastern Mud Turtle (*Kinosternon*

subrubrum) ranges in the Stones River watershed (Varner 1995), but was not found during the survey.

The richness of the herpetofauna at STRI undoubtedly is greater than that documented in this report. Additional species might be found if the survey was of a longer duration. Long-term studies at the Savannah River Ecology Laboratory in South Carolina suggest that although many species of amphibians and reptiles inhabiting a specific region are located in the initial years of study, long-term studies are required to accurately estimate total species richness and species distribution patterns (Gibbons et al. 1997, Gibbons 1997). Miller et al. (2005) conducted a two-year inventory of the amphibians and reptiles at Arnold Air Force Base in south-central Tennessee, 45 miles se of STRI. During the first year of the inventory they had documented 46 species, and by the end of the second year they had documented 55 species. With additional projects conducted at Arnold Air Force Base during the last seven years, the list has increased to 60 species. Perhaps with time a similar increase in species would occur at STRI. Certainly, several species not found during the inventory are common at Flat Rock Natural Area (FRNA), a 1,000+ acre preserve located just east of Murfreesboro, less than 12 km from STRI. Although FRNA lacks riparian corridors, the remaining terrestrial habitats are similar to those found at STRI (e.g. cedar glades and barrens, cedar forests, and hardwood forests). However, STRI and FRNA differ in one important aspect: FRNA and the surrounding environs have experienced relatively little development and essentially no agricultural use. Consequently, FRNA is not currently nor was it historically isolated from the surrounding natural landscape. Species found at FRNA, but not found at STRI include Fowler's Toad (*Bufo fowleri*), American Toad (*B. americanus*), Marbled Salamander (*Ambystoma opacum*), Six-lined Racerunner (*Cnemidophorus sexlineatus*), Smooth Earthsnake (*Virginia valeriae*), Timber Rattlesnake (*Crotalus horridus*),

and Copperhead (*Agkistrodon contortrix*). Each of these species is conspicuous and relatively easy to locate at FRNA (pers. obs.). Their absence at STRI suggests that they have been extirpated from the site, perhaps decades ago when the land now within park boundaries was actively engaged in agriculture. If so, the relative isolation of STRI could be preventing recolonization. The Stones River is the major colonization route currently in existence, but not all species expected to be found in STRI use riparian corridors for dispersal.

Although we were able to document only 50% of the amphibian and reptile species that have distributions within the Central Basin, STRI still serves as a potential refuge for at least 25 species. Nearly all of the amphibian species found in STRI require ephemeral, semipermanent, or permanent bodies of water to successfully reproduce. The Zigzag Salamander (*Plethodon dorsalis*) is the only completely terrestrial species. The other amphibian species are dependent on the wetlands, generally those that are fish-free. With the obvious exception of the Stones River, permanent wetlands are uncommon at STRI. Consequently, most of the amphibian species at STRI are dependent on the seasonal wetlands for successful reproduction. In particular, Lake Gerashe is a large wetland in the Main Battlefield Park. Unfortunately, this site has been greatly altered in the recent past by agricultural practices, including construction of a drainage ditch. King Pond, located in the Artillery Monument, supported a diverse assemblage of amphibians and reptiles. At least three species of amphibians use this pond as a breeding site, and several species of reptiles are common inhabitants of the pond and its margins. The preservation of these wetlands should be given high priority in the management of the herpetofaunal species.

Comparative Effectiveness of Survey Techniques

The survey techniques varied in their effectiveness at detecting the presence of amphibian and reptile species. However, the techniques also differ in their statistical rigor, repeatability, or usefulness in determining population structure or habitat preference. Also, we did not detect 100% of the species documented by any one-method; therefore, clear goals should be determined prior to the beginning of an inventory. Nevertheless, more species were recorded during VES than any during other survey technique (25 of the 29 species), indicating that this technique is capable of detecting the greatest number of species in a variety of habitats.

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Table 1. Species and numbers of amphibians and reptiles observed at Stones River National Battlefield, Rutherford County, Tennessee, from 15 April 2003 through 12 July 2004. The nomenclature follows Crother et. al. 2000. AM = Artillery Monument, FR = Fortress Rosecrans, MP = Main Battlefield Park, RB = Redoubt Brannan.

Taxon	AM	FR	MP	RB	TOTAL
FROGS					
1) <i>Acris crepitans</i> Baird	4	0	2	4	10
2) <i>Gastrophryne carolinensis</i> (Holbrook)	0	2	1	0	3
3) <i>Hyla chrysoscelis</i> Cope	1	0	10	0	11
4) <i>Pseudacris feriarum</i> (Baird)	0	1	0	0	1
5) <i>Rana catesbeiana</i> Shaw	218	2	3	4	227
6) <i>Rana sphenocephala</i> Cope	31	1	3	0	35
7) <i>Scaphiopus holbrookii</i> (Harlan)	0	0	4	0	4
SALAMANDERS					
1) <i>Ambystoma tigrinum</i> (Green)	0	0	1*	0	1
2) <i>Eurycea lucifuga</i> Rafinesque	0	1	0	0	1
3) <i>Plethodon dorsalis</i> Cope	0	1	24	1	26
4) <i>Notophthalmus viridescens</i> (Rafinesque)	0	0	2	0	2
LIZARDS					
1) <i>Eumeces fasciatus</i> (Linnaeus)	11	0	4	1	16
2) <i>Eumeces laticeps</i> (Schneider)	12	0	6	0	18
3) <i>Sceloporus undulatus</i> (Bosc and Daudin)	7	1	27	0	35
4) <i>Scincella lateralis</i> (Say)	1	0	0	0	1
SNAKES					
1) <i>Coluber constrictor</i> Linnaeus	4	1	10	1	16
2) <i>Elaphe obsoleta</i> (Say)	0	0	5	0	5

3) <i>Lampropeltis getula</i> (Linnaeus)	6	0	5	2	13
4) <i>Lampropeltis triangulum</i> (Lacepede)	0	0	2	0	2
5) <i>Nerodia sipedon</i> (Linnaeus)	5	4	0	1	10
6) <i>Opheodrys aestivus</i> (Linnaeus)	2	1	3	0	6
7) <i>Regina septemvittata</i> (Say)	11	2	0	0	13
8) <i>Thamnophis sirtalis</i> (Linnaeus)	7	4	5	0	16

TURTLES

1) <i>Apalone spinifera</i> (Lesueur)	1	2	0	3	6
2) <i>Chelydra serpentina</i> (Linnaeus)	1	8	0	9	18
3) <i>Graptemys geographica</i> (LeSueur)	2	0	0	6	8
4) <i>Sternotherus odoratus</i> (Latreille)	1	36	0	58	95
5) <i>Terrepenne carolina</i> (Linnaeus)	4	6	4	2	16
6) <i>Trachemys scripta</i> (Schoepff)	12	51	0	132	195
TOTALS	341	124	121	224	810

* specimen found prior to the official start of the survey.

Table 2. Species and numbers of amphibians and reptiles observed at different habitat types at Stones River National Battlefield, Rutherford County, Tennessee, from 15 April 2003 through 12 July 2004.

	WP	WF	HF	CB	CF	AF	OF	RD	OT
FROGS									
1) <i>Acris crepitans</i>	7	1	0	1	0	0	1	0	0
2) <i>Gastrophryne carolinensis</i>	2	0	0	1	0	0	0	0	0
3) <i>Hyla chrysoscelis</i>	0	0	4	0	0	0	4	0	2
4) <i>Pseudacris feriarum</i>	0	0	0	0	0	0	1	0	0
5) <i>Rana catesbeiana</i>	53	2	0	0	0	0	3	0	0
6) <i>Rana utricularia</i>	27	0	0	0	0	0	7	0	1
7) <i>Scaphiopus holbrookii</i>	3	0	0	0	0	0	0	0	1
SALAMANDERS									
1) <i>Ambystoma tigrinum</i>	0	0	0	0	0	0	0	0	1
2) <i>Eurycea lucifuga</i>	0	0	1	0	0	0	0	0	0
3) <i>Plethodon dorsalis</i>	0	0	24	0	1	0	0	0	1
4) <i>Notophthalmus viridescens</i>	2	0	0	0	0	0	0	0	0
LIZARDS									
1) <i>Eumeces fasciatus</i>	2	4	6	0	4	0	0	0	0
2) <i>Eumeces laticeps</i>	4	0	4	6	1	0	0	2	1
3) <i>Sceloporus undulatus</i>	0	1	23	6	0	0	0	5	0
4) <i>Scincella lateralis</i>	1	0	0	0	0	0	0	0	0

Table 2. Species and numbers of amphibians and reptiles observed at Stones River National Battlefield, Rutherford County, Tennessee, from 15 April 2003 through 12 July 2004.* (continued).

	WP	WF	HF	CB	CF	AF	OF	RD	OT
SNAKES									
1) <i>Coluber constrictor</i>	0	2	2	9	0	0	2	0	1
2) <i>Elaphe obsoleta</i>	0	0	2	2	1	0	0	0	0
3) <i>Lampropeltis getula</i>	6	0	4	1	0	0	0	1	2
4) <i>Lampropeltis triangulum</i>	0	0	2	0	0	0	0	0	0
5) <i>Nerodia sipedon</i>	0	10	0	0	0	0	0	0	0
6) <i>Opheodrys aestivus</i>	0	0	4	0	2	0	0	0	0
7) <i>Regina septemvittata</i>	13	0	0	0	0	0	0	0	0
8) <i>Thamnophis sirtalis</i>	9	3	3	1	0	0	0	0	0
TURTLES									
1) <i>Apalone spinifera</i>	2	4	0	0	0	0	0	0	0
2) <i>Chelydra serpentina</i>	13	5	0	0	0	0	0	0	0
3) <i>Graptemys geographica</i>	1	7	0	0	0	0	0	0	0
4) <i>Sternotherus odoratus</i>	69	26	0	0	0	0	0	0	0
5) <i>Terrepenne carolina</i>	0	0	12	0	2	0	0	0	1
6) <i>Trachemys scripta</i>	130	64	0	0	0	0	0	0	1

* Abbreviations: WP = wetland that ponds, may be ephemeral, semipermanent, or permanent, WF= wetland that flows, stream or river, HF = hardwood forest, CB = cedar glade or barrens habitat, CF = cedar forest, AF = agricultural field, OF = old field, RD = road, OT = other.

Table 3. Relative success of sampling methods to document occurrence of amphibian and reptile species at Stones River National Battlefield, Rutherford County, Tennessee, from 15 April 2003 to 12 July 2004.*

	Call	VES	CB	$\frac{DFFT}{DFPT}$	$\frac{TT}{THT}$	MT	Road
FROGS							
<i>Acris crepitans</i>	7	3	0	0	0	0	0
<i>Gastrophryne carolinensis</i>	2	1	0	0	0	0	0
<i>Hyla chrysoscelis</i>	7	0	0	0	0	4	0
<i>Pseudacris feriarum</i>	1	0	0	0	0	0	0
<i>Rana catesbeiana</i>	12	2	0	3/23	0	18	0
<i>Rana sphenoccephala.</i>	1	6	0	6/14	0	8	0
<i>Scaphiopus holbrookii</i>	3	1	0	0	0	0	0
SALAMANDERS							
<i>Ambystoma tigrinum</i>	0	1	0	0	0	0	0
<i>Eurycea lucifuga</i>	0	1	0	0	0	0	0
<i>Plethodon dorsalis</i>	0	26	0	0/1	0	0	0
<i>Notophthalmus viridescens</i>	0	1	0	0	0	1	0
LIZARDS							
<i>Eumeces fasciatus</i>	0	6	5	3/2	0	0	0
<i>Eumeces laticeps</i>	0	7	5	6/0	0	0	0
<i>Sceloporus undulatus</i>	0	31	1	3/0	0	0	0
<i>Scincella lateralis</i>	0	0	1	0	0	0	0

Table 3. Relative success of sampling methods to document occurrence of amphibian and reptile species at Stones River National Battlefield, Rutherford County, Tennessee, from 15 April 2003 through 12 July 2004. (continued).

	Call	VES	CB	$\frac{\text{DFFT}}{\text{DFPT}}$	$\frac{\text{TT}}{\text{THT}}$	MT	Road
SNAKES							
<i>Coluber constrictor</i>	0	8	6	2/0	0	0	0
<i>Elaphe. obsoleta</i>	0	3	1	0	0	0	1
<i>Lampropeltis getula</i>	0	7	6	0	0	0	1
<i>Lampropeltis triangulum</i>	0	0	1	0	0	0	1
<i>Nerodia sipedn</i>	0	10	0	0	0	0	0
<i>Opheodrys aestivus</i>	0	4	0	0	0	0	2
<i>Regina septemvittata</i>	0	13	0	0	0	0	0
<i>Thamnophis sirtalis</i>	0	6	8	0	0	1	1
TURTLES							
<i>Apalone spinifera</i>	0	3	0	0	3/0	0	0
<i>Chelydra serpentina</i>	0	5	0	0	11/2	0	0
<i>Graptemys geographica</i>	0	3	0	0	4/1	0	0
<i>Sternotherus odoratus</i>	0	1	0	0	93/1	0	0
<i>Terrepene carolina</i>	0	14	0	2/0	0	0	0
<i>Trachemys scripta</i>	0	13	0	0/1	170/11	0	1
Total # of Species	7	27	9	8/5	5/4	5	6

* Abbreviations: Call = Frog call or chorus heard, VES = Visual Encounter Survey, CB = cover board, DFFT/DFPT = drift fence funnel trap/drift fence pit trap, TT/THT = turtle crab trap/turtle hoop trap, MT = minnow trap.

Appendix A. Checklist of amphibian and reptile species expected to occur at Stones River National Battlefield based on historical and current range maps that depict species in Rutherford County, Tennessee. The checklist is provisional because it is based on known and suspected distributions of amphibians and reptiles in Tennessee as depicted in Conant and Collins (1991) and Redmond and Scott (1996).

CLASS AMPHIBIA

Order Anura

Family	Scientific Name	Common Name
Bufonidae		
	<i>Bufo americanus</i> Holbrook	American Toad
	<i>Bufo fowleri</i> Hinckley	Fowler's Toad
Hylidae		
	<i>Acris crepitans</i> Baird	Northern Cricket Frog
	<i>Hyla chrysoscelis</i> Cope	Cope's Gray Treefrog
	<i>Pseudacris crucifer</i> (Wied-Neuwied)	Spring Peeper
	<i>Pseudacris feriarum</i> (Baird)	Southeastern Chorus Frog
Microhylidae		
	<i>Gastrophryne carolinensis</i> (Holbrook)	Eastern Narrow-mouthed Toad
Pelobatidae		
	<i>Scaphiopus holbrookii</i> (Harlan)	Eastern Spadefoot
Ranidae		
	<i>Rana catesbeiana</i> Shaw	American Bullfrog
	<i>Rana clamitans</i> Latreille	Green Frog
	<i>Rana palustris</i> LeConte	Pickerel Frog
	<i>Rana sphenocephala</i> Cope	Southern Leopard Frog

Order Caudata

Family Scientific Name

Common Name

Ambystomatidae

Ambystoma barbouri Kraus and Petraska

Streamside Salamander

Ambystoma maculatum (Shaw)

Spotted Salamander

Ambystoma opacum (Gravenhorst)

Marbled Salamander

Ambystoma tigrinum (Green)

Tiger Salamander

Cryptobranchidae

Cryptobranchus alleganiensis (Daudin)

Hellbender

Necturidae

Necturus maculosus (Rafinesque)

Mudpuppy

Plethodontidae

Desmognathus fuscus (Green)

Northern Dusky Salamander

Eurycea cirrigera (Green)

Southern Two-lined Salamander

Eurycea longicauda (Green)

Long-tailed Salamander

Eurycea lucifuga Rafinesque

Cave Salamander

Gyrinophilus palleucus McCrady

Tennessee Cave Salamander

Plethodon dorsalis Cope

Northern Zigzag Salamander

Plethodon glutinosus (Green)

Northern Slimy Salamander

Pseudotriton montanus Baird

Mud Salamander

Salamandridae

Notophthalmus viridescens (Rafinesque)

Eastern Newt

Order Squamata: Suborder Lacertilia

Family Scientific Name

Common Name

Status

Anguidae

Ophisaurus attenuatus Cope

Slender Glass Lizard

Phrynosomatidae

Sceloporus undulatus Bosc and Daudin

Eastern Fence Lizard

Scincidae

Eumeces fasciatus (Linnaeus)

Common Five-lined Skink

<i>Eumeces inexpectatus</i> Taylor	Southeastern Five-lined Skink
<i>Eumeces laticeps</i> (Schneider)	Broad-headed Skink
<i>Scincella lateralis</i> (Say)	Little Brown Skink

Teiidae

<i>Cnemidophorus sexlineatus</i> (Linnaeus)	Six-lined Racerunner
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Order Squamata: Suborder Serpentes

Family	Scientific Name	Common Name	Status
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Colubridae

<i>Carphophis amoenus</i> (Say)	Eastern Wormsnake
<i>Cemophora coccinea</i> Blumenbach	Scarletsnake
<i>Coluber constrictor</i> Linnaeus	Eastern Racer
<i>Diadophis punctatus</i> (Linnaeus)	Ring-necked Snake
<i>Elaphe obsoleta</i> (Say)	Eastern Ratsnake
<i>Heterodon platirhinos</i> Latreille	Eastern Hog-nosed Snake
<i>Lampropeltis getula</i> (Linnaeus)	Common Kingsnake
<i>Lampropeltis triangulum</i> (Lacepede)	Milksnake
<i>Nerodia sipedon</i> (Cope)	Northern Watersnake
<i>Opheodrys aestivus</i> (Linnaeus)	Rough Greensnake
<i>Regina septemvittata</i> (Say)	Queen Snake
<i>Storeria dekayi</i> Holbrook	Dekay's Brownsnake
<i>Storeria occipitomaculata</i> (Storer)	Red-bellied Snake
<i>Tantilla coronata</i> Baird and Girard	Southeastern Crowned Snake
<i>Thamnophis sirtalis</i> (Linnaeus)	Common Gartersnake

Viperidae

<i>Agkistrodon contortrix</i> (Linnaeus)	Copperhead
<i>Crotalus horridus</i> Linnaeus	Timber Rattlesnake

Order Testudines

Family	Scientific Name	Common Name
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Trinonychidae

<i>Apalone s. spinifera</i> (Lesueur)	Spiny Softshell
Chelydridae	
<i>Chelydra serpentina</i> (Linnaeus)	Snapping Turtle
Emydidae	
* <i>Chrysemys picta</i> (Schneider)	Painted Turtle
<i>Graptemys geographica</i> (LeSueur)	Northern Map Turtle
<i>Terrepene carolina</i> (Linnaeus)	Eastern Box Turtle
<i>Trachemys scripta</i> (Schoepff)	Pond Slider
Kinosternidae	
<i>Kinosternon subrubrum</i> (Lacepède)	Eastern Mud Turtle
<i>Sternotherus odoratus</i> (Latreille)	Stinkpot

*Although range maps depict this species in Rutherford County, no museum records are known to exist.

Appendix B. Dates for the different inventory methods used to survey the amphibian and reptile species at Stones River National Battlefield.

Technique	Date
Drift Fence (Box and Pitfall)	<p>2003: 30 May; 9, 14, 17, 26, June; 24 July; 13 Aug; 2, 6, 27 March; 30 April; 3, 9, 12, 14, 17, 26 June; 24 July; 13, 17 Aug; 19 Oct.</p> <p>2004: 7 Feb; 2, 6, 27 March; 11, 17 May; 3, 11, 12, 14, 25 June.</p>
Turtle Traps (Crab and Hoop)	<p>2003: 14, 28 Oct;</p> <p>2004: 24, 30 April; 1, 8, 21 May; 15, 22, 24, 26, 28 30 June; 2, 6, 9, 10, 12 July.</p>
Minnow Traps	<p>2004: 18 Jan; 2, 28 Feb; 2, 5, 27 March; 17, 27 April; 11, 17 May; 2, 11, June.</p>
Visual Encounter Survey	<p>2003: 6 May; 31 Oct; 16, 31 Dec.</p> <p>2004: 2 Jan; 10, 20, 28 Feb., 5, 13, 15, 27, 30 March; 1, 3, 6, 10, 17, 27, 28, 30 April; 1, 8, 11, 13, 14, 17, 18, 19, 21 May; 12, 15, 16, 17, 24 June; 12 July.</p>
Cover Boards	<p>2003: 29 June; 6, 17, 27 July; 3, 8, 10, 29 Aug.; 14, 23, 27, Sept.; 5, 12, 19 Oct.; 2 Nov.</p> <p>2004: 15 March; 1, 17, April; 11 May; 5 June.</p>

Appendix C. List of photographs of amphibians and reptiles found at Stones River national Battlefield, Rutherford County, Tennessee.

Species	Image #
FROGS	
<i>Acris crepitans</i>	3065
<i>Gastrophryne carolinensis</i>	3389
<i>Rana catesbeiana</i>	2223, 2238
<i>Rana sphenocephala</i>	2294
<i>Scaphiopus holbrookii</i>	3340
SALAMANDERS	
<i>Ambystoma tigrinum</i>	0001
<i>Eurycea lucifuga</i>	0583
<i>Plethodon dorsalis</i>	1864
TURTLES	
<i>Apalone spinifera</i>	3279, 3683, 3749
<i>Chelydra serpentina</i>	3226, 3274, 3294, 3570, 3661, 3674, 3756
<i>Graptemys geographica</i>	2935, 2963, 3194, 3676, 3768
<i>Sternotherus odoratus</i>	3185
<i>Terrapene carolina</i>	3209, 0584
<i>Trachemys scripta</i>	2227, 2239, 2250, 2247, 3271, 3565

Appendix C. List of photographs of amphibians and reptiles found at Stones River National Battlefield, Rutherford County, Tennessee. (continued).

Species	Image #
LIZARDS	
<i>Eumeces laticeps</i>	3325, 3369, 0667
<i>Sceloporus undulatus</i>	2487, 3025
SNAKES	
<i>Coluber constrictor</i>	2921
<i>Elaphe obsoleta</i>	3362, 3378
<i>Lampropeltis getula</i>	3211, 2471
<i>Lampropeltis triangulum</i>	0931
<i>Nerodia sipedon</i>	3063
<i>Opheodrys aestivus</i>	0576, 0579, 0659
<i>Regina septemvittata</i>	2951, 3037, 3222
<i>Thamnophis sirtalis</i>	2498, 2524, 3204, 2910