# HERPETOFAUNA OF FORT DONELSON NATIONAL BATTLEFIELD, STEWART COUNTY, TENNESSEE

JON M. DAVENPORT

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A. Floyd Scott, Major Professor

We have read this thesis and
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# HERPETOFAUNA OF FORT DONELSON NATIONAL BATTLEFIELD, STEWART COUNTY, TENNESSEE

A Thesis

Presented for the

Master of Science Degree

Austin Peay State University

Jon M. Davenport

August 2005

## ACKNOWLEDGMENTS

First, I would like to thank Dr. A. Floyd Scott for all his help during the course of this study. His morals and character will serve as a model for me to follow. I would also like to thank Dr. Mack Finley for his open door policy and open-mindedness. His editing and birding abilities are truly underappreciated. Thanks also to Dr. Andy Barrass for his introducing me to the world of GIS and for helping me prepare distribution maps. Without, the encouragement and friendship of all the aforementioned, this project would not have been completed.

For assistance with field work, I thank Josh Ennen, Nathan Parker, and Josh Maloney. For supplying funding, field vehicles, and equipment, thanks go to Austin Peay's Center for Field Biology. And for helping with many logistical needs, thanks also to the Park Service for funding and to all the Fort Donelson Park staff, especially Ranger Robert Wallace.

Thanks also to the Clarksville Old Towne gang for help during stressful periods. Thanks are also extended to TWRA Region IV staff, specifically Pete Wyatt, who provided a firm background in conservation and the complex details of state work.

Finally, I would like to express my love and appreciation to my family in return for their support throughout this endeavor. Their aid in many forms made this thesis possible.

## LIST OF FIGURES

## ABSTRACT

Fort Donelson National Battlefield is a 243-ha (600-acre) national park situated on the Cumberland River at Dover in Stewart County, Tennessee. Located on the western edge of the Western Highland Rim, it is a highly dissected area of ridges and ravines covered mainly by oak-hickory forest. Prior to this study, despite much work in surrounding areas, no information was available on the herpetofauna of the park. To remedy this, the following objectives were established: 1) provide an inventory of herpetofauna within the Battlefield, 2) describe the species richness, abundance, and distribution of these animals, and 3) provide data on the comparative effectiveness of the assortment of survey techniques to be used. Sampling techniques employed included cover board arrays and area searches in randomly selected plots, time-constrained searches along stream stretches, drift fences with pit and funnel traps at a vernal pond, night and day road surveys, and hand capture upon incidental encounters.

The study was conducted from January 2004 to June 2005. During the course of the study, 37 species of herpetofauna (17 amphibians and 20 reptiles) were documented. This represents 66% of the 56 species considered possible for the area. None of the species found are considered rare, endangered or of special concern by federal or state authorities. Voucher specimens will be housed in the APSU Museum of Zoology along with a Microsoft Excel file containing the raw data from the study. Funding for this study was provided by Austin Peay State University's Center of Excellence for Field Biology and the National Park Service.

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# CHAPTER I

## INTRODUCTION

National parks in the United States represent undisturbed environments and potential corridors for organisms to move from ecosystem to ecosystem (National Park Service 2003a). In 1998, the U.S. Congress passed the National Parks Omnibus Management Act. This act expressed concern for biodiversity and the lack of monitoring of the biota within all national parks. The act also called for inventory data to be collected in each national park for population and diversity assessment (National Park Service, 2003a).

Amphibians and reptiles (collectively constituting the herpetofauna) in various areas of northwestern Middle Tennessee have been described by Scott (1967), Scott and Snyder (1968), Snyder (1972), Scott et al. (1980), Redmond et al. (1982), Scott et al. (1984), Van Norman (1985), Van Norman and Scott (1987), Scott (1991), Zirkle (1993), Rozelle and Scott (1995), Scott et al. (1995), White (1997), Fitch (1998), Rozelle (1999), Bufalino (1999), Scott and Williamson (1999), Williamson (2001), Scott et al. (2000), Scott (2002), and Bufalino and Scott (2002), thus providing sound data on herpetofaunal diversity within the ecoregion. Despite all of this information, no data exists, published or unpublished, on the herpetofauna of Fort Donelson National Battlefield. Thus a herpetofaunal survey at Fort Donelson is needed to provide base-line data on a significant part of the vertebrate fauna of the area and fill a void that exists in knowledge of these animals on government-owned lands in the region.

Both reptile and amphibian populations have recently been demonstrated (Gibbons et al., 2000) to be experiencing declines worldwide. Habitat loss and

fragmentation have been identified as main causes (Gibbons and Stangel, 1999). Landscape alteration and forest management techniques have also been shown to impact herptile communities (Block et al., 1998,; DeMaynadier and Hunter, 1995). Herpetofaunal community compositions worldwide need to be evaluated to determine habitat use and their consequential conservation needs.

Long-term monitoring of the status of populations is the key to assessing the causes of their decline (Marsh and Goicochea, 2003). A few programs in North America have been established to monitor amphibian populations, but these programs do not include reptile monitoring. A surveying protocol must be established to monitor both amphibians and reptiles before population declines become critical.

The goal of this study is to provide an inventory of the herpetofauna of Fort Donelson National Battlefield in Stewart County, Tennessee. More specifically, an understanding of the species diversity, abundance, and distribution of these animals within the park is being sought. Also the study will provide data on the comparative effectiveness of the assortment of survey techniques to be used.

# CHAPTER II

# DESCRIPTION OF THE STUDY AREA

## Location and Size

Fort Donelson National Battlefield is a 243-ha (600-acre) national park (National Park Service, 2003b), located 1.6 km (1 mile) west of Dover, Tennessee (Figure 1). The entire park is located within Stewart County, Tennessee. The park is bordered by Barkley Lake (impounded Cumberland River) to the north and U.S. Highway 79 to the south.

## History

Fort Donelson National Battlefield was created in 1930 by Public Law 187. Land acquisition followed for the next two years. Restoration of the Forts earthworks was also begun in 1931 along with historical interpretation planning. This provided the backbone of the park for development of roads, plaques, and reestablishment of native hardwoods. In 1933, Fort Donelson was transferred from the Department of War to the National Park Service where it has remained until present. Land was obtained in various increments until 1989 to form the park as it exists today (Chester and Wallace, 1997).

## Physiography, Geology, Soils, Topography, and Hydrology

Fort Donelson is located in the Highland Rim Section, Western Highland Rim Subsection of the Interior Low Plateaus province (Quarterman and Powell, 1978). The bedrock of the park is of upper Mississippian age composed of various slowly soluble cherty limestone (United States Department of Agriculture, 1953). Narrow ridges, hills, ravines, steep slopes, and floodplains provide the park with diverse habitats and

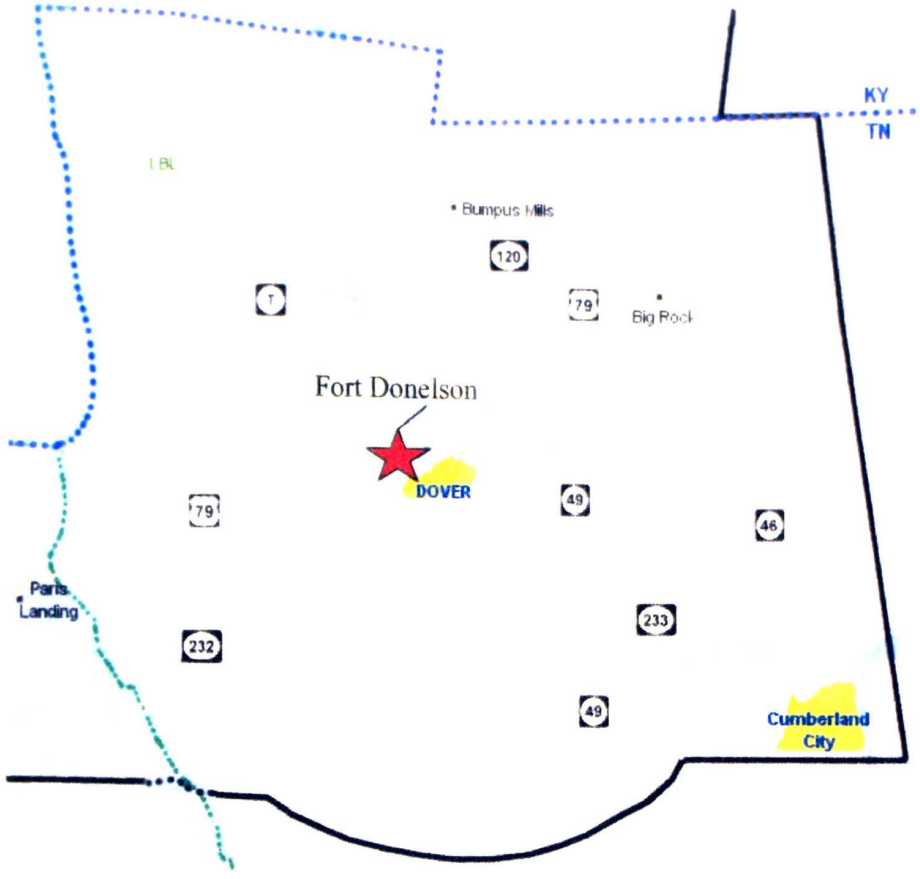


Figure 1. Location of Fort Donelson (red star) 1.6 km (one mile) west of Dover, in Stewart County, Tennessee.

topography. Also, two vernal ponds and two permanent streams are present that serve as living and breeding areas for amphibians (Petranka 1998). One stream, Indian Creek, flows intermittently through an approximate 450-m stretch of the Battlefield (Figure 2).

Elevations in the Park range from 110 m (360 feet) on the river to 168 m (550 feet) on the ridges (Chester, 1986). Most of the soils are rocky and shallow, thus nutrient poor. Twenty-five soil types are found within the Park boundaries. The dominate of these are cherty, droughty, Bodine, and Baxter soils (Springer and Elder, 1980).

## Vegetation

Fort Donelson is part of the Western Mesophytic Forest Region subsection of the Mississippi Plateau Section as described by Braun (1950). The general forest vegetation pattern is oak and oak-hickory dominated (Chester, 1986). Most of the park is deciduous forest with scattered agricultural fields. Some fields are being restored with native warm-season grasses while others are being mowed for aesthetic value (Figure. 2). All forests within the park boundaries are considered secondary due to previous logging and agricultural disturbances before park development (Chester and Wallace, 1997).

## Weather and Climate

Stewart County is described as a warm-temperate, continental climate (USDA, 1953). Based on weather data collected over a 30-year period (1971-2000) at Dover and accessible from the Southeast Regional Climate Center's web site (http://www.dnr.state.sc.us/water/climate/sercc), means for temperature and precipitation in the area are as follows: annual temperature, 14 C; coldest month – January, 1 C; warmest month at – July, 25 C; annual precipitation, 135 cm; wettest month – March, 14 cm; driest month – October, 9 cm.

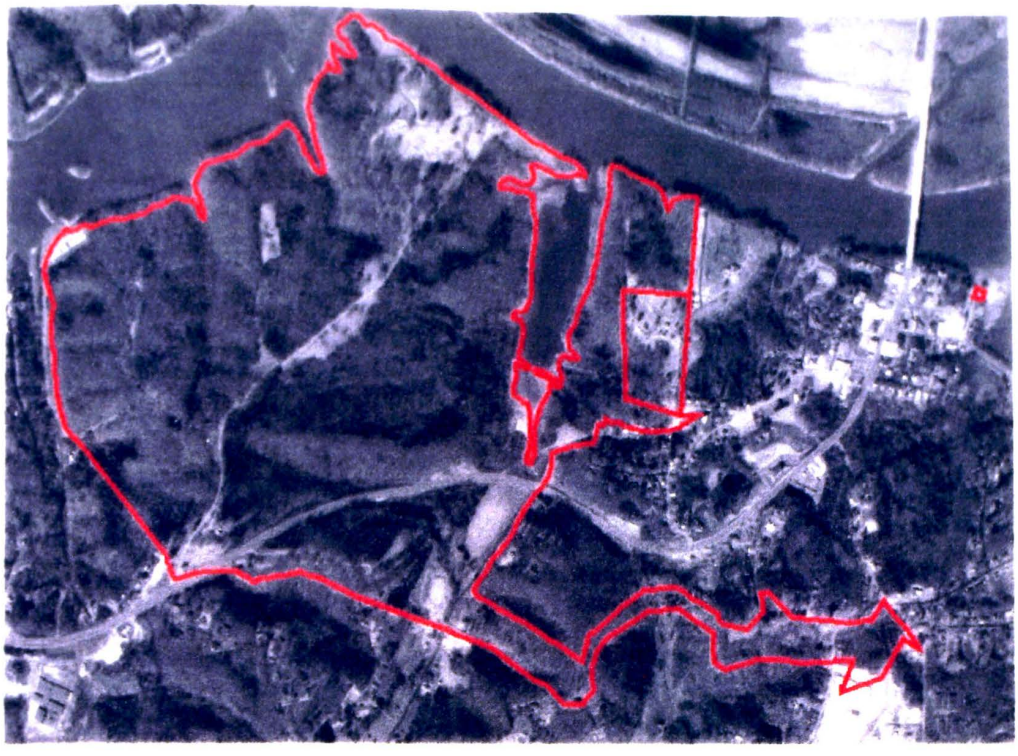

Figure 2. Aerial photo of Fort Donelson showing park boundary (red line). Photo provided by United States National Park Service.

Monthly means for temperature and precipitation at Fort Donelson over much of the study period can be seen in Figures 3 and 4.

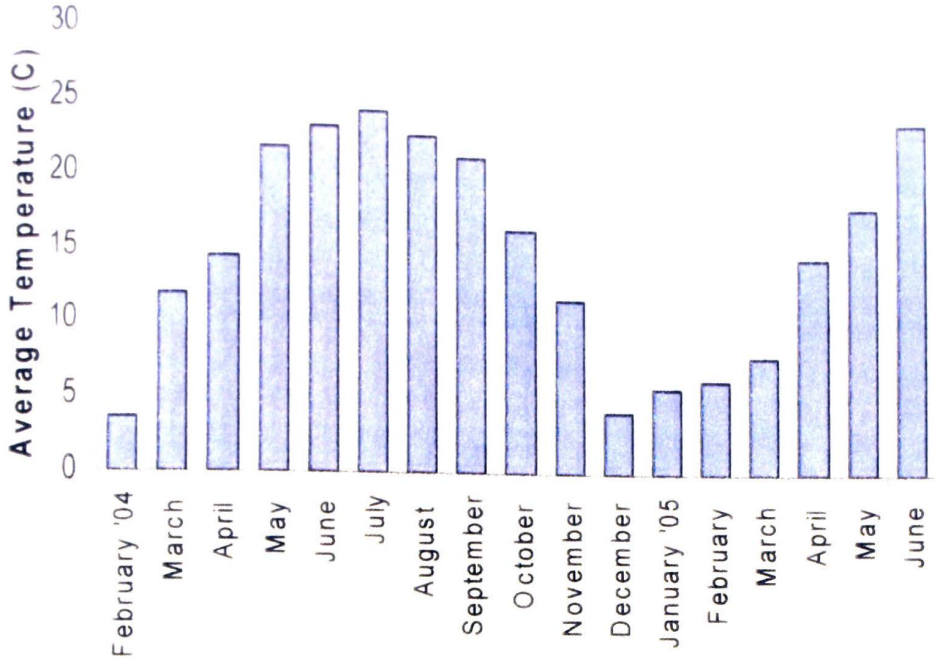


Figure 3. Average monthly temperatures for Fort Donelson from February 2004 through June 2005. Data provided by the National Park Service.

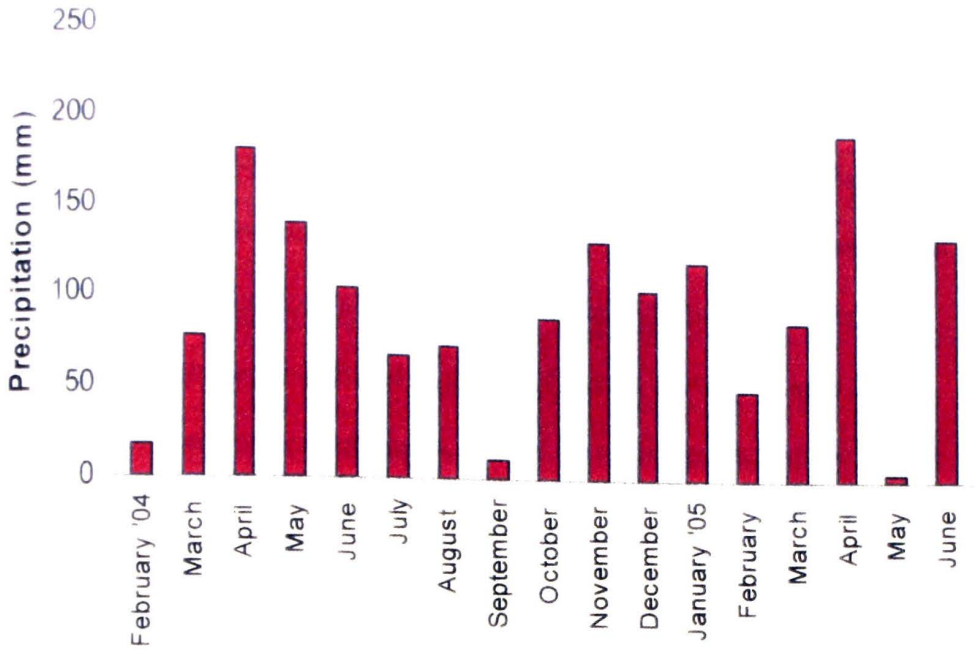


Figure 4. Total monthly precipitation at Fort Donelson National Battlefield from February 2004 through June 2005. Data provided by the National Park Service.

# CHAPTER III

# MATERIALS AND METHODS

## Target Population

The target population for this study was all amphibians and reptiles that reside within Fort Donelson National Battlefield. By major groups, this includes members of the orders Caudata (salamanders), Anura (frogs and toads), Testudines (turtles), and Squamata (lizards and snakes). Based on published reports of occurrences in Land Between the Lakes and other nearby areas, a list of the species projected to be present appears in Table 1.

## Survey Methods

Fifteen randomly selected 1-ha plots served as the basis for sampling the Fort Donelson herpetofauna (Figure 5). These plots were established by the Natureserve organization for use by all researchers involved in inventorying the biodiversity of the Battlefield. Twelve of these plots fell within common wooded habitats in the park, whereas three were in partially open, successional or maintained fields. Each 1-ha plot had two intersecting transects of 30 m each (Figure 6). One transect ran East-West, while the other ran North-South. Ten meters out from the center point (intersect) in each direction along each transect, a piece of artificial cover was placed on the ground. The cover objects placed along one transect were 140 by 140-cm sheets of roofing tin; along the other transect cover objects consisted of sheets of untreated plywood measuring 140 by 140 by 0.65 cm. Beginning at 12 m from the center of each transect and extending to 20 m in each direction, areas for constrained searches were marked off (National Park Service, 2003a). These areas (called ACS areas) were 8 by 8 m in size (Figure 5).

**Table 1.** List of species of amphibians and reptiles expected to occur within the boundaries of Fort Donelson National Battlefield based on published and unpublished distribution data and reported habitat preferences. A single asterisk (*) marks those that are highly likely to occur, a double asterisk (**) those considered very likely to occur, and a triple asterisk (***) those whose occurrence was least likely.

| AMPHIBIANS (24 species) | REPTILES (32 species) |
|---|---|
| *Notophthalmus viridescens* - Eastern Newt* | *Terrapene carolina* - Eastern Box Turtle* |
| *Ambystoma maculatum* - Spotted Salamander* | *Trachemys scripta* – Red-Eared Slider Turtle* |
| *Ambystoma opacum* - Marbled Salamander** | *Sceloporus undulatus* - Fence Lizard* |
| *Ambystoma texanum* - Smallmouth Salamander*** | *Cnemidophorus sexlineatus* - Six-lined Racerunner*** |
| *Ambystoma tigrinum* - Tiger Salamander* | *Eumeces fasciatus* - Five-lined Skink* |
| *Desmognathus conanti* - Spotted Dusky Salamander* | *Eumeces inexpectatus* - Southeastern Five-lined Skink** |
| *Eurycea cirrigera* - Southern Two-lined Salamander* | *Eumeces laticeps* - Broad-headed Skink* |
| *Eurycea longicauda* - Long-tailed Salamander* | *Scincella lateralis* - Ground Skink* |
| *Eurycea lucifuga* - Cave Salamander** | *Carphophis amoenus* - Eastern Wormsnake* |
| *Plethodon dorsalis* - Zigzag Salamander* | *Cemophora coccinea* - Scarletsnake** |
| *Plethodon glutinosus* - Northern Slimy Salamander* | *Coluber constrictor* - Eastern Racer* |
| *Pseudotriton ruber* - Red Salamander** | *Diadophis punctatus* - Ring-necked Snake* |
| *Scaphiopus holbrookii* - Eastern Spadefoot** | *Pantherophis spiloides* - Central Ratsnake* |
| *Bufo americanus* - American Toad* | *Heterodon platirhinos* - Eastern Hognose Snake** |
| *Bufo fowleri* - Fowler's Toad* | *Lampropeltis calligaster* - Prairie Kingsnake** |
| *Acris crepitans* - Northern Cricket Frog* | *Lampropeltis getula* - Common Kingsnake* |
| *Hyla versicolor* complex - Gray Treefrog* | *Lampropeltis triangulum* - Milksnake** |
| *Hyla cinerea* - Green Treefrog** | *Nerodia erythrogaster* - Plain-bellied Watersnake** |
| *Pseudacris crucifer* - Spring Peeper* | *Nerodia rhombifer* - Diamondback Watersnake** |
| *Pseudacris feriarum* - Southeastern Chorus Frog** | *Nerodia sipedon* - Common Watersnake* |
| *Gastrophryne carolinensis* - Eastern Narrow-mouthed Toad* | *Opheodrys aestivus* - Rough Greensnake* |
| *Rana catesbeiana* - Bullfrog* | *Pituophis melanoleucus* – Pinesnake* |
| *Rana clamitans* - Green Frog* | *Regina septemvittata* - Queen Snake*** |
| *Rana sphenocephala* - Southern Leopard Frog* | *Storeria dekayi* - Dekay's Brownsnake* |
| | *Storeria occipitomaculata* - Red-bellied Snake* |
| | *Tantilla coronata* - Southeastern Crowned Snake** |
| | *Thamnophis sauritus* - Eastern Ribbon Snake*** |
| | *Thamnophis sirtalis* - Common Garter Snake* |
| | *Virginia valeriae* - Smooth Earth Snake* |
| | *Agkistrodon contortrix* - Copperhead* |
| | *Crotalus horridus* -Timber Rattlesnake** |
| | *Sistrurus miliarius* - Pygmy Rattlesnake*** |

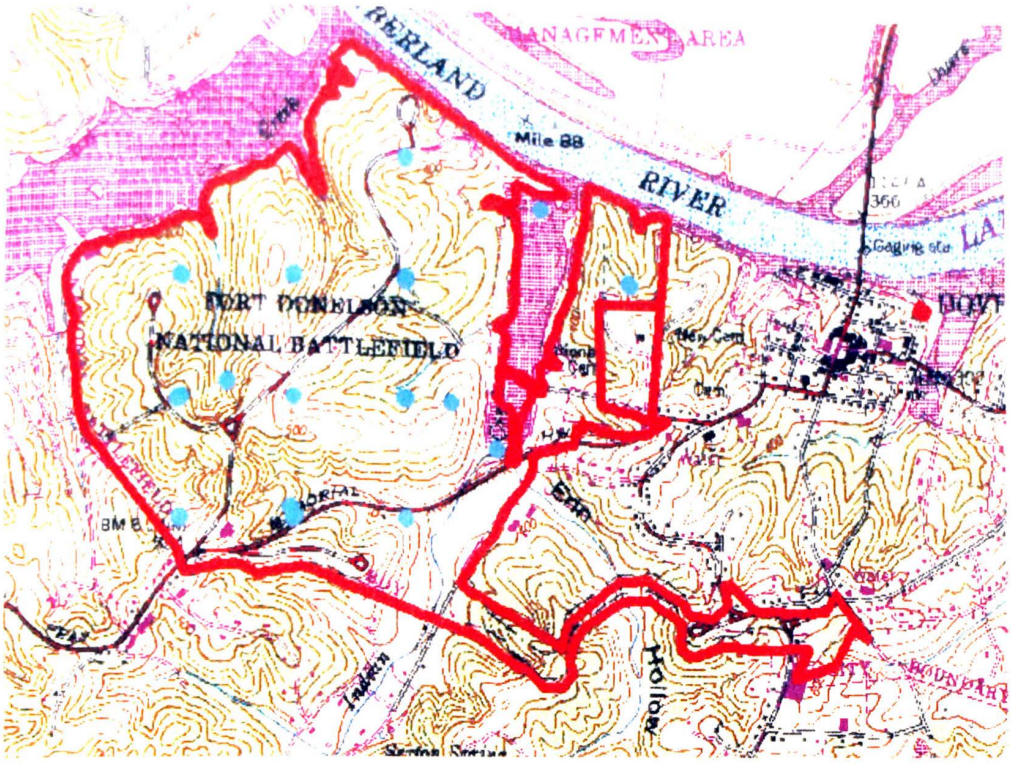


Figure 5. Boundary of Fort Donelson National Battlefield and centers (blue dots) of 15 plots established by Natureserve for biotic surveys on the area.

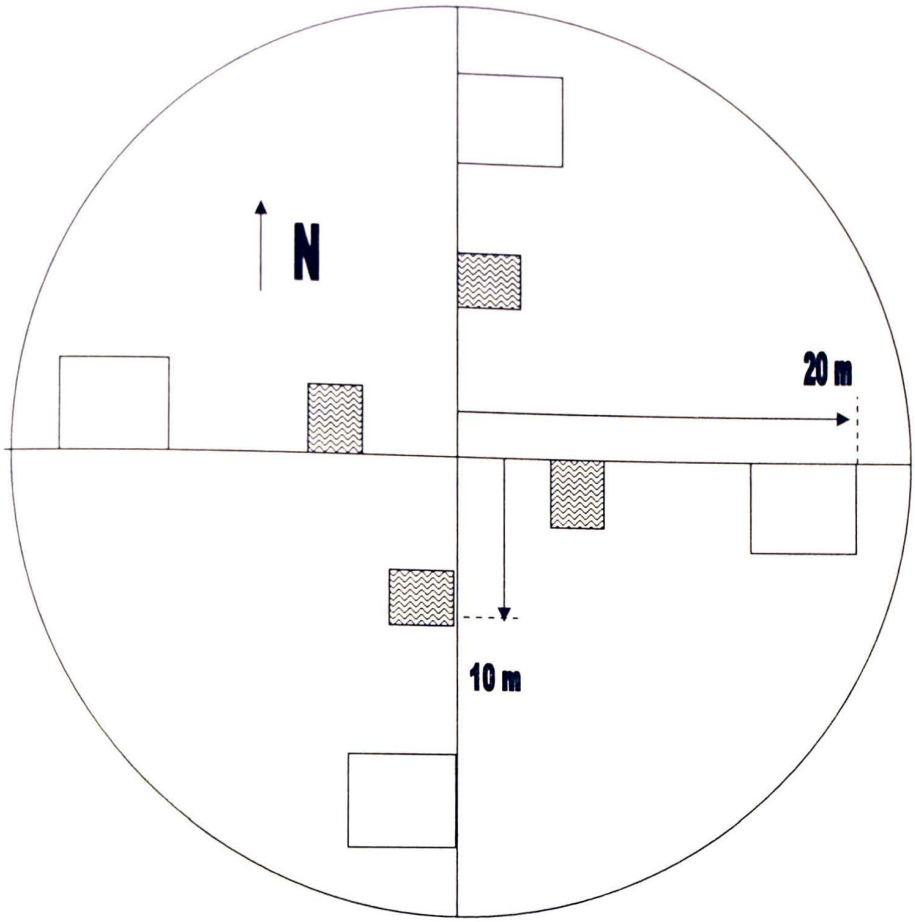


Figure 6: Diagram of the 1-ha random plot showing the location of the four 8 $m^2$ constrained-search-area plots and the four cover boards (NPS, 2003).

$8m^2$ constrained-search-area plots

Cover boards

## Special Habitats

Around one of the two vernal pools in the park, a drift fence (Dodd and Scott, 1994) with pitfall traps was erected to capture animals. Along each of the park's two small streams, a 100-m reach was marked off and searched at least once monthly. Road cruising at night (Shaffer and Juterbock, 1994) during each of the four seasons was also conducted along the park's 3.7 km (2.3 miles) of roads.

## Sampling Schedule and Protocols

The park was visited at least twice monthly with many weekly visits during peak activity periods from January 2004 through June 2005. Usually, sites were visited once weekly when weather or time allowed. On each visit, a potato rake was used to lift pieces of artificial cover in each plot to check for animals taking refuge there. Rocks and other forest debris were also overturned by hand in the ACS areas. At least once monthly, each 100-m reach of stream marked for study was searched manually working upstream throughout its length. Throughout all seasons, even if water was no longer present, drift fences at ponds and wetlands were checked twice monthly. The actual number of times per month the various sites were visited appears in Table 2.

## Data Collection

Each organism captured was measured or assessed for the following: mass, age class, snout-vent length (SVL), sex, and reproductive condition (National Park Service, 2003a). Abiotic data recorded each time a specimen was encountered included: date, time of day, temperature (air plus water or soil), and description of microhabitat. General weather conditions and weather conditions over the past 24 hours were also noted on each visit.

Table 2. Numbers of times per month over the study period that each of the sampling stations was visited.

| | Sampling Sites | | | | | | |
|---|---|---|---|---|---|---|---|
| Month | Random Plots | Tin Transect | Pond with Drift Fence | Streams Reaches | Pond Without Drift Fence | Roads | Total |
| January '04 | 2 | - | 3 | 1 | - | 3 | 9 |
| February | 2 | - | 6 | 3 | - | 6 | 17 |
| March | 2 | 2 | 4 | 3 | 4 | 8 | 26 |
| April | 2 | 6 | 8 | 3 | 3 | 8 | 30 |
| May | 2 | 3 | 3 | 3 | 1 | 5 | 17 |
| June | 3 | 5 | 5 | 3 | 2 | 7 | 25 |
| July | 3 | 5 | 7 | 2 | 1 | 7 | 25 |
| August | 2 | 4 | 5 | 4 | 2 | 8 | 25 |
| September | 4 | 7 | 8 | 4 | 1 | 11 | 35 |
| October | 3 | 5 | 6 | 2 | 1 | 8 | 25 |
| November | 3 | 5 | 7 | 1 | 1 | 8 | 25 |
| December | 1 | 1 | 2 | 2 | 1 | 2 | 9 |
| January '05 | 1 | 1 | 2 | 1 | 1 | 4 | 10 |
| February | 2 | 3 | 5 | 2 | 5 | 7 | 24 |
| March | 2 | 2 | 3 | 3 | 4 | 5 | 19 |
| April | 2 | 2 | 4 | 2 | 2 | 4 | 16 |
| May | 2 | 2 | 2 | 2 | 2 | 3 | 13 |
| June | 2 | 2 | 2 | 1 | 2 | 4 | 13 |
| Total | 40 | 55 | 82 | 42 | 33 | 108 | 311 |

A Global Positioning System (GPS) receiver was used to take the coordinates of each animals capture location. Soil samples were collected once each month and returned to the lab for pH analysis.

## Identification and Nomenclature

Identification was made using keys by Altig (1970), Conant and Collins (1991), and Mount (1975). With a few exceptions, scientific nomenclature follows that used by Crother et al. (2000).

## Record Keeping and Voucher Specimens

All data obtained in the study were recorded in the field on custom designed data sheets (Appendix A) and later transferred to a Microsoft Access data base file for management and analysis. For documentation purposes, a voucher (either specimen or photograph) of each species found in the park was accessioned into Austin Peay State University's Museum of Zoology. A copy of field notes taken throughout the study was deposited in the Austin Peay State University Museum of Zoology.

# CHAPTER IV

# RESULTS

## Taxa Encountered

Since January 2004, 110 days in the field yielded 386 records representing 37 species (17 amphibians and 20 reptiles). A list of these along with the numbers of times each was documented in the Battlefield's four major habitats (stream and streamside, pond, field, forest) appears in Table 3. Table 4 provides the sampling method or methods by which each species was detected.

Of the amphibian species encountered, there were 7 salamanders and 10 frogs and toads. Among the 20 reptile species were 2 turtles, 4 lizards, and 14 snakes. All species have been previously reported from the region (Snyder, 1972) and none are listed at any level of conservation concern (United States Fish and Wildlife Service, 2005; Tennessee Department of Environment and Conservation, Division of Natural Heritage, 2004).

The 37 species found represent 66% of the expected 56 species anticipated as possible residents of the area. Of the 36 species considered highly likely to occur on the area, 32 (88%) were documented. Beyond this group, twenty-seven percent (4 of 15) of the very likely to occur species was documented (*Eurycea lucifuga, Hyla cinerea Pseudacris feriarum*, and *Lampropeltis triangulum*), while 20% (1 of 5) of the least likely to occur category was encountered (*Regina septemvittata*). Sixty-two voucher specimens including at least one of each species were retained for deposition in the Austin Peay State University Museum of Zoology.

Table 3. Species of amphibians and reptiles documented from January 2004 through June 2005 at Fort Donelson, sampling methods detected by, and the number of times each was encountered in the four major habitats on the area. HS = Haphazard searches, RC = Road cruising, and RP = Random plot searches.

| Species –Common Name | Sampling Method(s) | Major Habitats | | | | |
|---|---|---|---|---|---|---|
| | | Stream/ Streamside | Pond Site | Field | Forest | Totals |
| Salamanders | | | | | | |
| *Notophthalmus viridescens* - Eastern Newt | RC | | | 1 | | 1 |
| *Ambystoma maculatum* - Spotted Salamander | HS, RC | | 1 | | 1 | 2 |
| *Desmognathus conanti* - Spotted Dusky Salamander | HS | 14 | | | | 14 |
| *Eurycea cirrigera* - Southern Two-lined Salamander | HS | 5 | | | | 5 |
| *Eurycea lucifuga* - Cave Salamander | HS, RP | | | 1 | 1 | 2 |
| *Plethodon dorsalis* - Zigzag Salamander | HS, RP | | 46 | | 27 | 73 |
| *Plethodon glutinosus* - Northern Slimy Salamander | HS, RP | | 6 | | 32 | 38 |
| Frogs or toads | | | | | | |
| *Bufo americanus* - American Toad | ALL | | 8 | | 11 | 19 |
| *Bufo fowleri* - Fowler's Toad | ALL | 1 | 21 | 2 | 21 | 43 |
| *Acris crepitans* - Northern Cricket Frog | HS | 1 | | | | 1 |
| *Hyla versicolor* complex. - Gray Treefrog | RC | | | | 2 | 2 |
| *Hyla cinerea* - Green Treefrog | RC | | | 1 | 7 | 8 |
| *Pseudacris crucifer* - Spring Peeper | HS | | 6 | | | 6 |
| *Pseudacris feriarum* - Southeastern Chorus Frog | HS | | 8 | | 3 | 11 |
| *Rana catesbeiana* – Bullfrog | HS, RP | 1 | 2 | | | 3 |
| *Rana clamitans* - Green Frog | RC | | | | 1 | 1 |
| *Rana sphenocephala* - Southern Leopard Frog | ALL | 2 | 13 | | 1 | 16 |
| Turtles | | | | | | |
| *Terrapene carolina* - Eastern Box Turtle | ALL | 1 | | 2 | 33 | 36 |
| *Trachemys scripta*- Red-Eared Slider | HS, RC | 2 | | | 3 | 5 |
| Lizards | | | | | | |
| *Sceloporus undulatus* - Fence Lizard | HS, RP | | 4 | 2 | 3 | 9 |
| *Eumeces fasciatus* - Five-lined Skink | HS, RP | | | | 3 | 3 |
| *Eumeces laticeps* - Broad-headed Skink | HS | | 1 | | | 1 |
| *Scincella lateralis* - Ground Skink | HS, RP | | | 2 | 12 | 14 |
| Snakes | | | | | | |
| *Carphophis amoenus* - Eastern Wormsnake | HS, RP | | | | 2 | 2 |
| *Coluber constrictor* - Eastern Racer | ALL | | | 9 | 5 | 14 |
| *Diadophis punctatus* - Ring-necked Snake | HS, RP | | | 5 | 15 | 20 |
| *Pantherophis spiloides* - Central Ratsnake | RC | | | | 1 | 1 |
| *Lampropeltis getula* - Common Kingsnake | ALL | | | 8 | 4 | 12 |
| *Lampropeltis triangulum* – Milksnake | RC | | | | 1 | 1 |
| *Nerodia sipedon* - Common Watersnake | HS | 1 | | | 1 | 2 |
| *Opheodrys aestivus* - Rough Greensnake | RC | | | | 1 | 1 |
| *Regina septemvittata* - Queen Snake | HS | 1 | | | | 1 |
| *Storeria dekayi* - Dekay's Brownsnake | HS | | | 2 | | 2 |
| *Storeria occipitomaculata* - Red-bellied Snake | HS | | | 1 | | 1 |
| *Thamnophis sirtalis* - Common Garter Snake | HS, RP | 1 | | | 1 | 2 |
| *Virginia valeriae* - Smooth Earth Snake | HS, RP | | | 9 | 3 | 12 |
| *Agkistrodon contortrix* – Copperhead | RC | | | | 2 | 2 |
| Totals | | 30 | 116 | 45 | 197 | 386 |

## Abundance and Distribution

### Amphibians

Amphibians were more abundant in spring than in any other season (Figure 7). This was especially true for frogs and toads whose species richness declined progressively over the annual cycle. In contrast, salamander numbers remained fairly constant across the seasons, except for a decided drop in the summer. The most species caught in one month occurred during June 2004 when 9 species were logged (Figure 8).

*Plethodon dorsalis* and *P. glutinosus* were the most abundant salamander species encountered depending on the season. Both were found mainly in the upland deciduous forest habitat with a few found near an upland pond site. *Eurycea lucifuga* and *Ambystoma maculatum* were uncommon throughout the park probably due to a lack of limestone caverns in the case of the former and insufficient breeding pools in the latter's case. *Bufo fowleri*, *B. americanus*, *Rana sphenocephala* were the most abundant anuran species. These organisms were encountered at multiple habitats including upland deciduous forest, old fields, ponds, and roads. The least encountered anurans were *Hyla cinerea*, *H. versicolor* complex., *Rana clamitans* and *Acris crepitans*. This may have resulted from the lack of favorable or be an artifact stemming from inadequate sampling.

### Reptiles

Reptiles exhibited a stepwise decrease in richness from spring through winter (Figure 9). This trend held for all reptile groups, with the exception of lizards, whose species numbers peaked in summer and fell to zero in winter. More reptiles species were caught in September 2004 (11 species) than during any other month of the study (Figure 8).

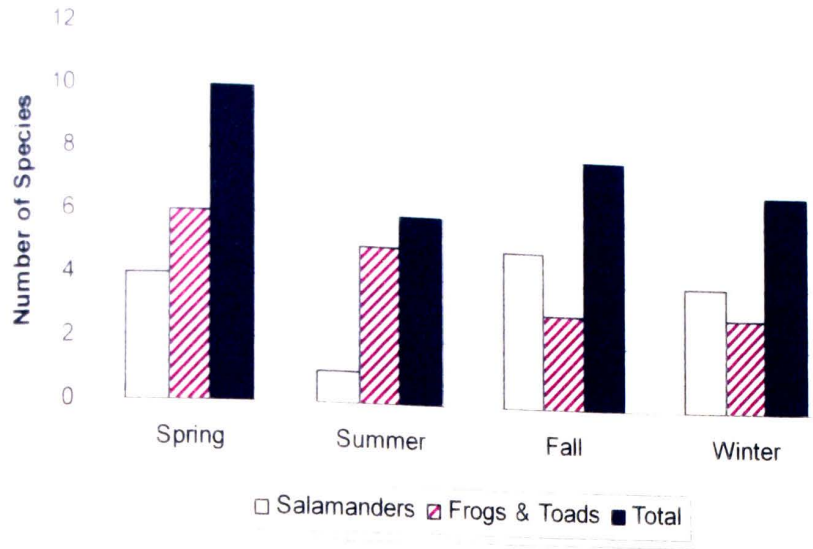


Figure 7. Seasonal abundance of the major groups of amphibian species documented at Fort Donelson National Battlefield, Stewart County, Tennessee from January 2004 to May 2005.

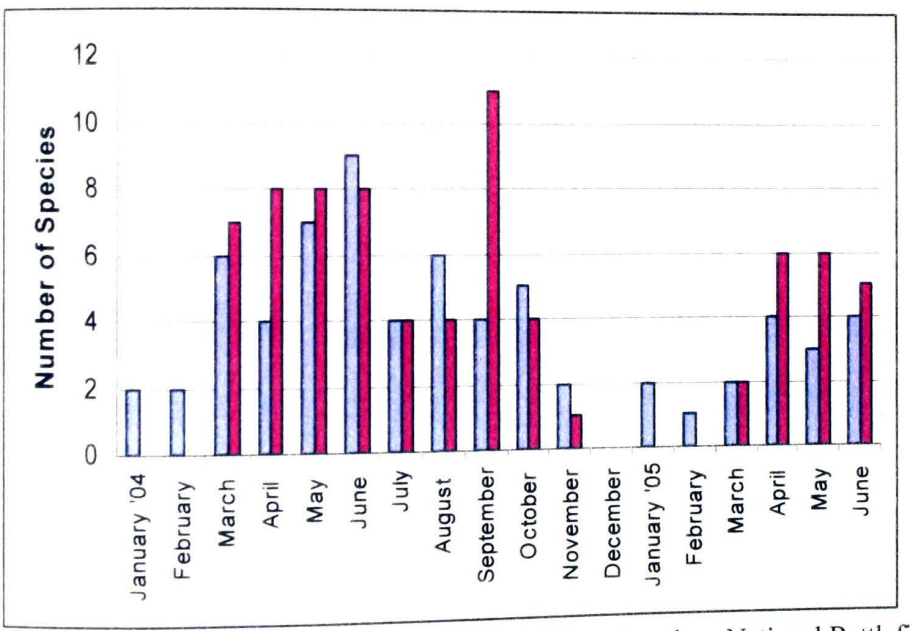


Figure 8. Monthly number of species caught at Fort Donelson National Battlefield, January 2004 to June 2005. The blue bars are amphibians and the red bars are reptiles.

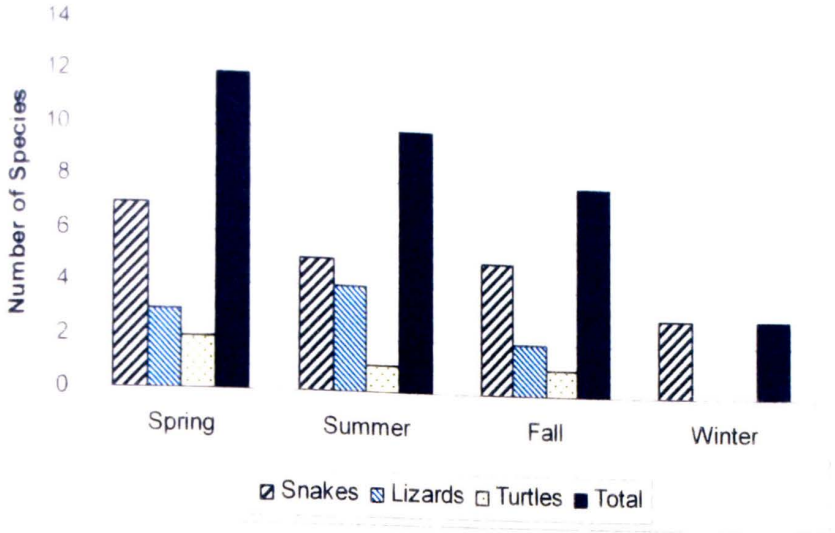


Figure 9. Seasonal abundance of the major groups of reptile species documented at Fort Donelson National Battlefield, Stewart County, Tennessee from January 2004 to May 2005.

*Diadophis punctatus* was the most common snake species found. *Coluber constrictor* and *Lampropeltis getula nigra* were the next most frequently encountered snakes. *Lampropeltis triangulum*, *Opheodrys aestivus*, and *Agkistrodon contortrix* were the least common snake species with only one specimen of each documented. *Scincella lateralis* was the most abundant lizard species found at Fort Donelson.

All species were recorded in old fields and upland deciduous forest habitats. *Terrepene carolina* was the most abundant of the two turtle species encountered. It was widely distributed throughout the park in a wide array of habitats (old fields, streamside, and upland deciduous forest). *Trachemys scripta* was primarily found in and along Indian Creek near its confluence with Barkley Lake.

The distribution of the major herpetofaunal groups (frogs and toads, salamanders, lizards, snakes, and turtles) as documented in this study at Fort Donelson can be seen in Figure 10. Individual species distribution maps, alphanumeric by genus, are located in Appendix A.

## Sampling Effectiveness

Surveys of special habitats were the most productive sampling methods utilized during this study. This technique yielded 25 species of herpetofauna. Haphazard searches and road cruising followed closely yielding 20 species encountered and random plots yielded 16 species (Figure 11). Among the random plots, tin cover objects were most effective for sampling reptiles.

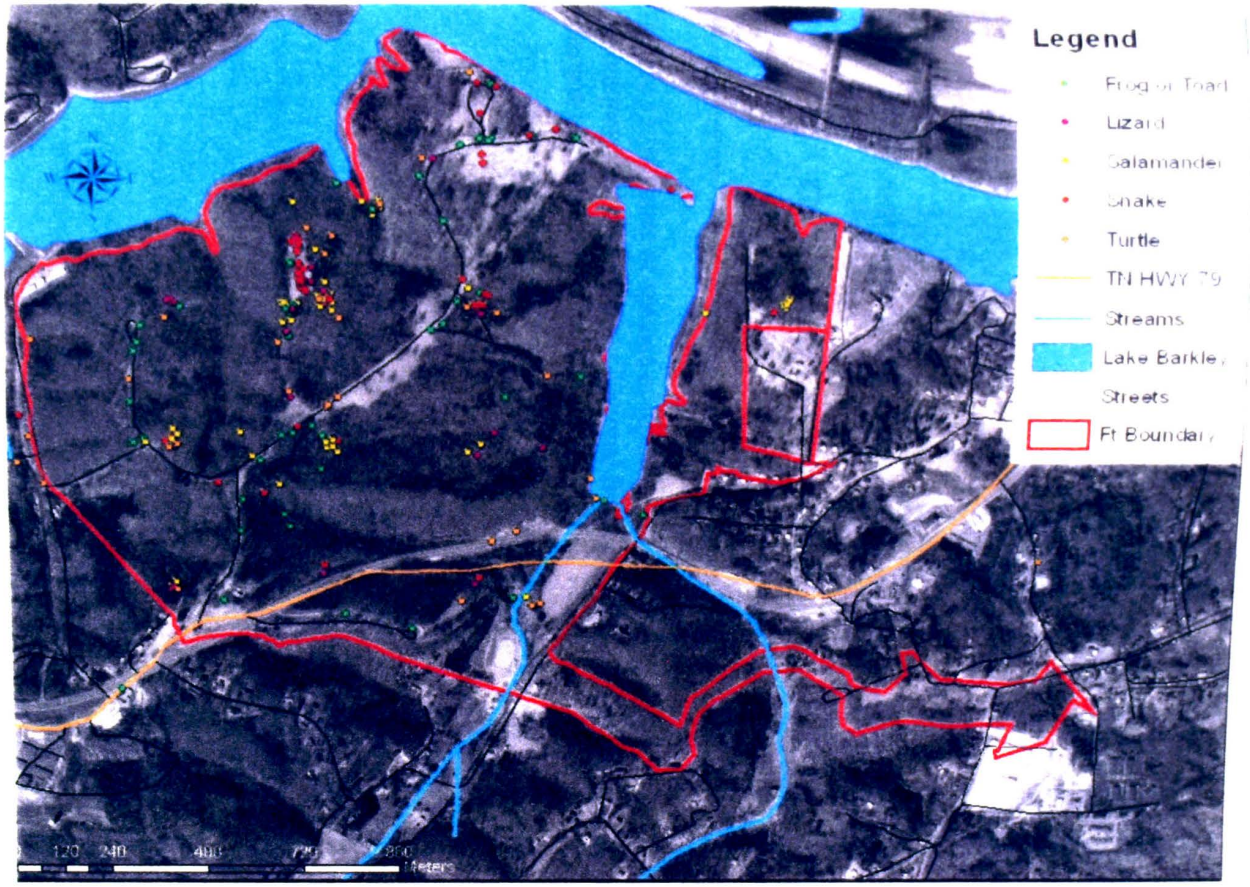


Figure 10. Distribution of records logged for the 5 major herpetofaunal groups at Fort Donelson National Battlefield, Stewart County, Tennessee from January 2004 to May 2005.

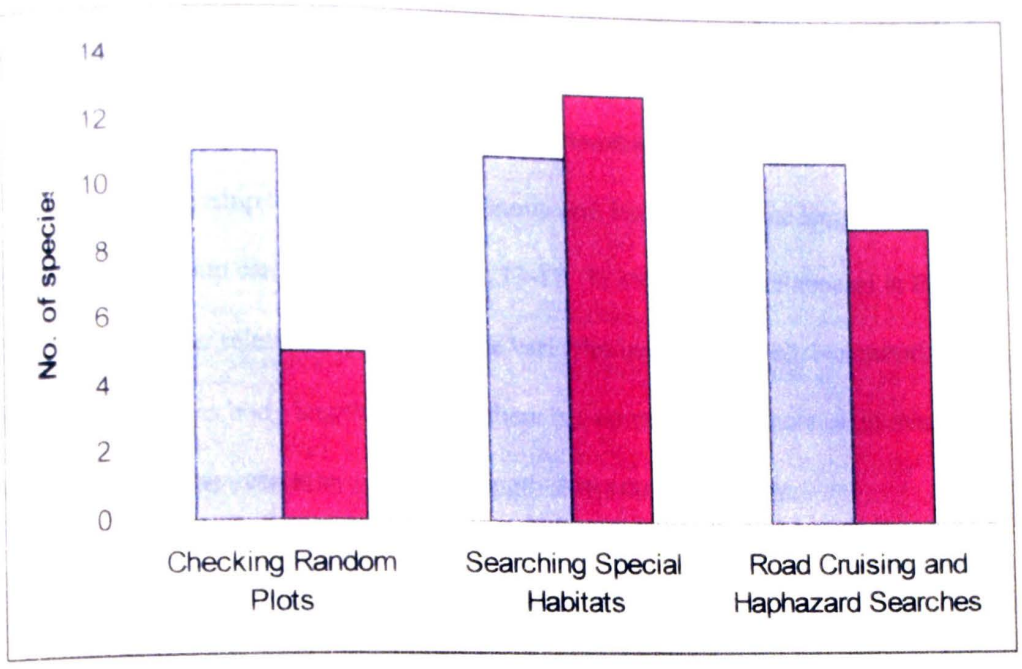


Figure 11. Number of species of reptiles and amphibians detected by various sampling techniques for Fort Donelson National Battlefield. Blue bars indicate reptiles and maroon indicates amphibians.

Area constrained searches within the random plots were best for amphibian sampling (Figure 12).

## Mass-Length Relationships

The relationship between mass and snout-vent length (carapace length in turtle) for each major group can be seen in Figures 13-17. In each case there appears to be a linear to curvilinear relationship between the variables being compared. Not surprisingly, this indicates that as body length increases there is a corresponding increase in mass, which may continue even after growth in length slows down or ceases.

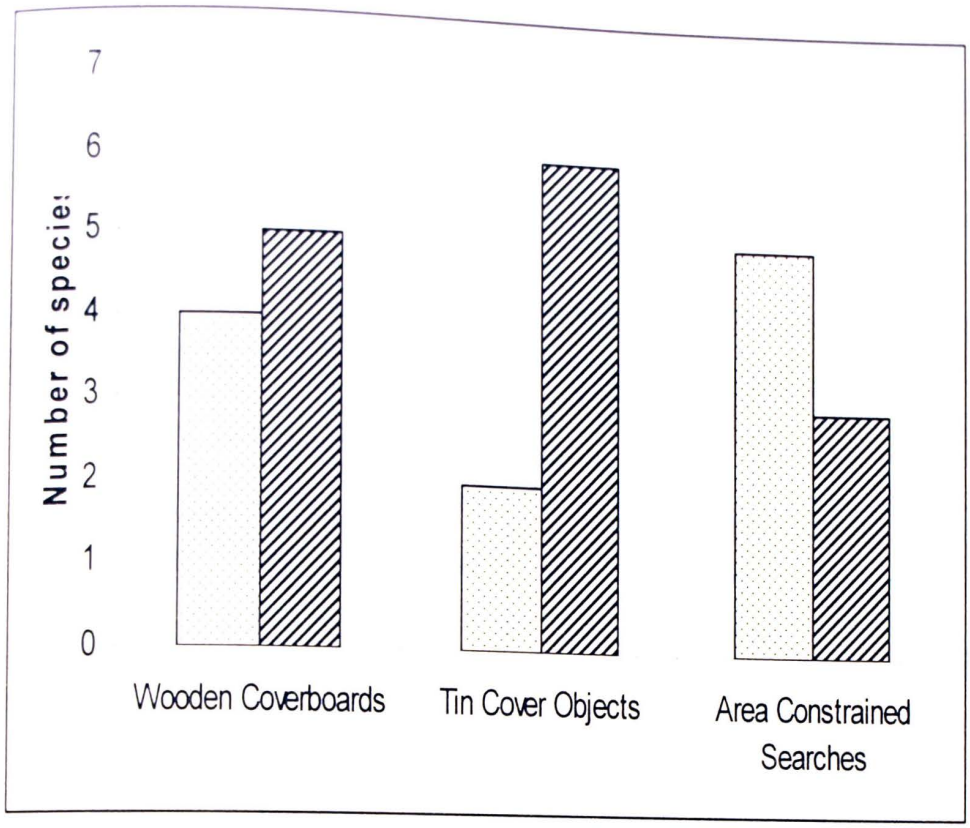


Figure 12. Random plot productivity by technique. White columns with dots represent amphibians and columns with stripes represent reptiles.

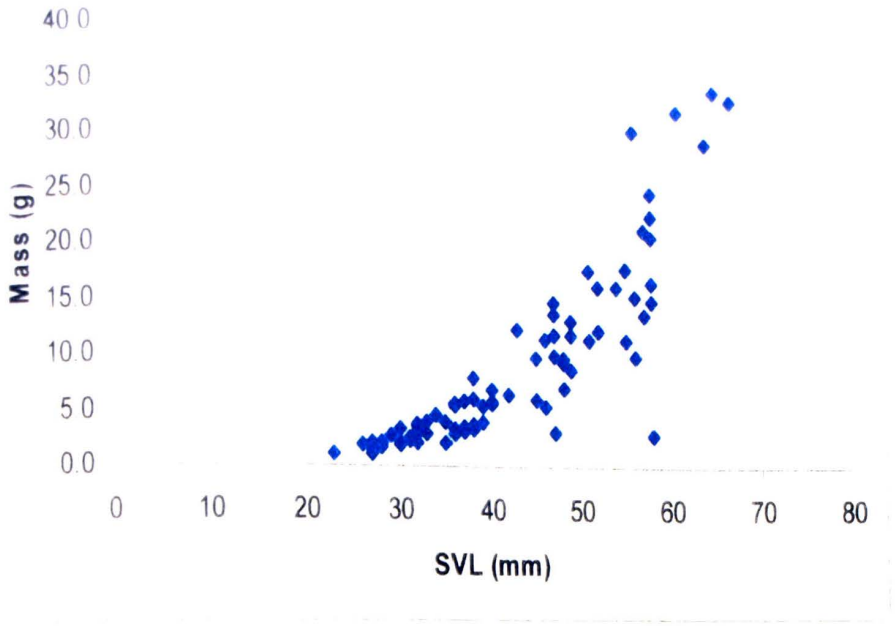


Figure 13. Mass versus snout-vent length (SVL) of all frogs and toads caught at Fort Donelson from January 2004 to June 2005.

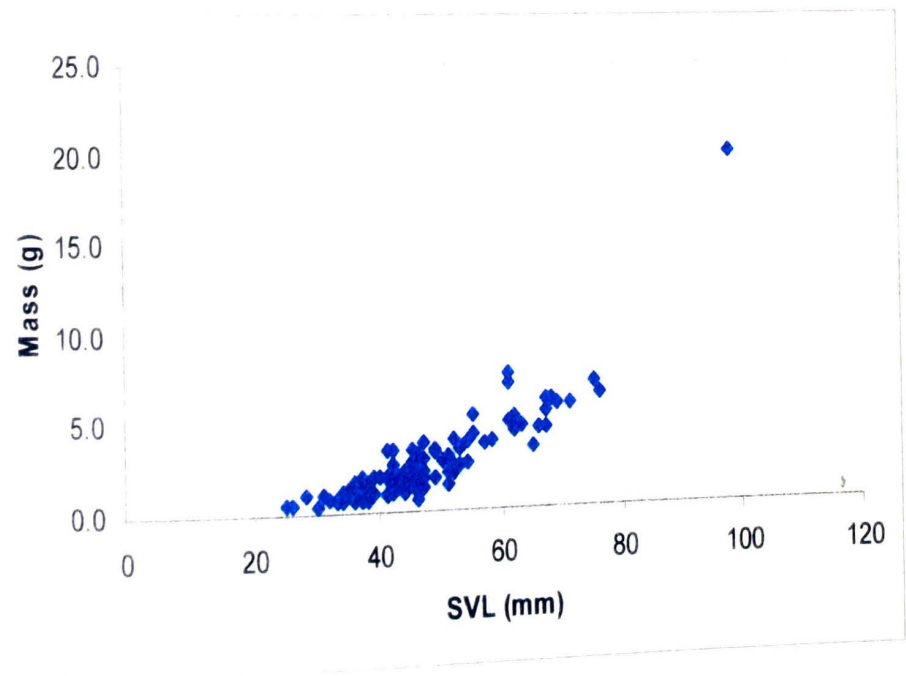


Figure 14. Mass versus snout-vent length (SVL) of all salamanders caught at Fort Donelson from January 2004 to June 2005.

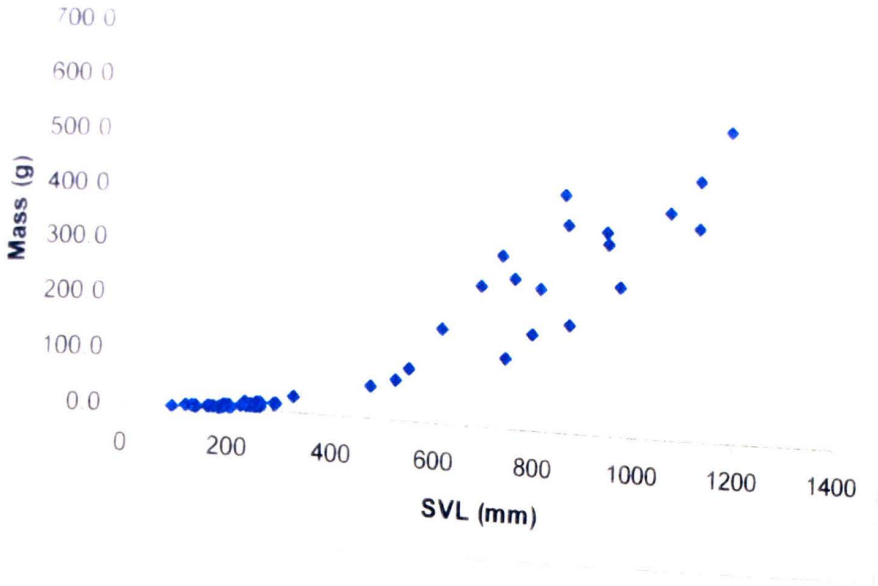


Figure 15. Mass versus snout-vent length (SVL) of all snakes caught at Fort Donelson from January 2004 to June 2005.

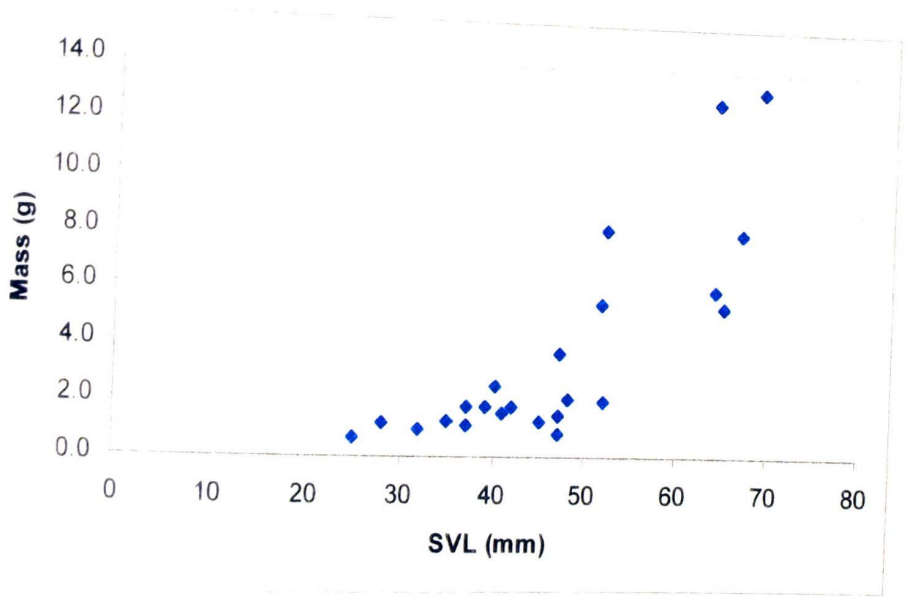


Figure 16. Mass versus snout-vent length (SVL) of all lizards caught at Fort Donelson from January 2004 to June 2005.

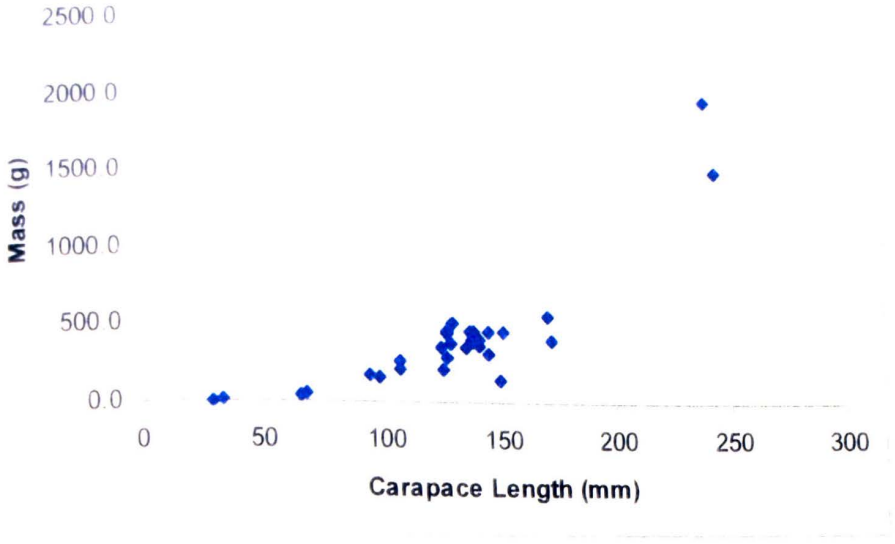


Figure 17. Mass versus carapace length of all turtles caught at Fort Donelson from January 2004 to June 2005.

# CHAPTER V

## DISCUSSION

A number of reasons may exist why only 37 of the expected 56 species were found at Fort Donelson. First, the numbers of individuals of certain species may be so low that they were simply overlooked. Second, many herpetofaunal species, as suggested by Derge et al. (2001), are naturally elusive because of their fossorial nature, nocturnal behavior or cryptic coloration. Third, the list of expected species was based on regional data for the surrounding ecoregion which includes a variety of habitats and topographic features that are not found at Fort Donelson. Fort Donelson is a relatively small resource patch with some form of regular human disturbance.

For example, only 2 specimens of *Ambystoma maculatum* were found at the battlefield. This species is very common throughout the Western Highland Rim as described in other local studies (Scott, 1967, Scott and Snyder, 1968, Snyder, 1972). Two ponds were located on park premises; however, neither held water for an extended period of time. Ponds are essential for reproduction in most amphibian species (Petranka, 1998). Continued monitoring within the Fort should document species not found in this study.

Seasonal abundance data for both groups of herpetofauna are almost identical to Zirkle (1993) with the exception that more reptiles were found in the spring at Fort Donelson. The abundance of these groups mainly in spring and summer is directly related to their ectotherm life history. An ectotherm cannot function at full capacity when variables such as temperature, habitat, and refugia are not favorable or readily available. The monthly breakdown of capture totals provides additional support for each groups peak activity period.

An assortment of inventory methods (described above) were deployed to sample the Fort's herpetofauna. Of these, visual searches proved most successful in terms of species richness. Most records obtained in this manner came while road cruising, especially during rains, within the deciduous forest habitat. This also was the least labor intensive survey method employed. The random plots produced the lowest species richness. This may be due to the fact that only one plot was located outside the deciduous forest habitat in an open field. Thus habitat diversity was very low among the random plots resulting in low species richness and diversity. These results reflect the ideas of Ryan et al. (2002), who suggested that no single sampling method is likely to reveal the presence of all species of herpetofauna within a particular region.

Within the random plots, cover objects made of tin were more successful for reptiles possibly due to its ability to absorb heat. This thermal energy may have attracted reptiles, and increased their ability to function. Area-constrained searches were conducted where no artificial cover existed but natural cover objects (fallen logs, leaf litter, and rocks) that remained moist beneath throughout the year were present. Salamanders were mainly found in these search grids and appeared to prefer the natural cover objects. Recent studies have found artificial cover objects are more beneficial in preventing habitat destruction and conserving time; however, in this study without the area-constrained searches, a smaller yield of salamanders would likely have resulted (Monti, Hunter, and Witham, 2000). Both techniques proved successful in detecting salamanders; however area-constrained searches took more time.

Anurans were found in all habitats (stream, pond, field, and forest). The presence of some species (*Hyla cinerea*) on roads in the upland deciduous forest habitat was

somewhat surprising because there was no suitable breeding habitat nearby. Perhaps their presence was the result of them dispersing from or moving to favorable habitat in the floodplain of the adjacent Cumberland River. Some animals (e.g. *Scaphiopus holbrooki*) may have been missed because they are explosive breeders and were simply not encountered when above ground. Salamanders of 4 species (*Notophthalmus viridescens*, *Ambystoma maculatum*, *Plethodon dorsalis*, and *Plethodon glutinosus*) were found mainly in deciduous forest habitat, many in pit traps near the edge of a ephemeral woodland pond. Two salamander species (*Desmognathus conanti* and *Eurycea cirrigera*) were found exclusively in stream beds, in or along the water's edge. *Eurycea lucifuga* was a surprising find due to lack of limestone rock outcrops and openings. One individual was observed beneath a stack of treated logs of the type used for waterbreaks along the parks trails. Another was captured under a natural cover object within one of the random plots.

Turtles were also found in 3 of the 4 habitats (creek, field, and forest). *Terrepene carolina* was ubiquitous in its distribution throughout the Fort. Driving roads after rains was most productive, followed by haphazard searches. *Trachemys scripta* was mainly found in or along the permanent stream, not surprising since it is highly aquatic species. Some individuals encountered were observed laying eggs or emerging as hatchings from eggs laid on land near the stream. Lizards were predominantly found in the deciduous forest, some near the woodland pond. A few were encountered in the field habitat. Snakes preferred the field habitat due likely to increased exposure to sunlight and higher abundance of prey.

The lack of juvenile individuals among all major herp groups was alarming. Reproduction may not be occurring at the Fort, but this is unlikely since suitable habitat is available to all groups with the possible exception of frogs. A more likely explanation for this phenomenon may be that survey techniques employed simply failed to detect juveniles or dispersing young, therefore causing a sampling bias. Using sampling methods specifically designed to capture young individuals might reveal this observation to be unfounded.

# CHAPTER VI

## CONCLUSIONS

The following conclusions were drawn based on the data obtained in this study:

1. The herpetofauna at Fort Donelson is similar to that previously reported from other areas of the Western Highland Rim ecoregion.
2. Deciduous forest was the dominant habitat at the Fort and supported the greatest species richness; stream and pond habitats supported the least number of species.
3. Seasonal abundance of amphibians is highest in the fall and spring seasons. Reptiles were more abundant in spring and summer seasons. Both groups experienced the lowest abundance during winter.
4. Searching special habitats (ponds and streams) was the most productive sampling method for reptiles and amphibians. Tin cover objects were preferred by reptiles at random plots, while natural cover objects were preferred by amphibians.
5. Continued monitoring of Fort Donelson herpetofauna is recommended to provide more information for use in devising conservation and management strategies.

# LITERATURE CITED

# Literature Cited

Altig, R. A. 1970. A key to the tadpoles of the continental United States and Canada. Herpetologica 26:180-207.

Braun, E. L. 1950. Deciduous forests of eastern North America. The Blakiston Publishing Co., Philadelphia, Pennsylvania.

Bufalino, A. 1999. *Nerodia erythrogaster* (plainbelly water snake) in the lower Cumberland River Basin: an evaluation of its distribution, habitat, and taxonomic status. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Bufalino, A.P. and A.F. Scott. 2002. The distribution of *Nerodia erythrogaster* in the lower Cumberland River basin of Kentucky and Tennessee. Herpetological Review 34:77-78.

Block, W.M., M.L. Morrison, and P.E. Scott. 1998. Development and evaluation of habitat models for herpetofauna and small mammals. Forest Science 44:430-437.

Chester, E.W. 1986. The Vascular Flora of Fort Donelson National Military Park, Stewart County, Tennessee. National Park Service, Atlanta.

Chester, E.W. and B.J. Wallace. 1997. Fort Donelson National Battlefield: A Botanical and Historical Perspective. Center for Field Biology, Austin Peay State University, Clarksville, Tennessee.

Conant R. and J.T. Collins. 1991. A field guide to reptiles and amphibians of eastern and central North America, 3rd ed. Houghton Mifflin Co., Boston, Massachusetts.

Crother, B.I., J. Boundy, J.A. Campbell, K. De Queiroz, D.R. Frost, R. Highton, M.E. Seidel, J.W. Sites Jr., T.W. Taggart, S.G. Tilley, and D.B. Wake. 2000. Scientific and standard English names of amphibians and reptiles of North America North

of Mexico, with comments regarding confidence in our understanding. Soc. Study Amphib. Rep. Herpetol. Cir. Num. 29.

Derge, K.L., R.H. Yahner, and J. Mravintz. Survey of reptiles and amphibians in Gettysburg National Park with reference to Michaux State Forest. Journal of the Pennsylvania Academy of Science 75:43-49.

DeMaynadier, P.G., and M.L. Hunter, Jr. 1995. The relationship between forest management and amphibian ecology: a review of the North American literature. Environmental Review 3:230-261.

Dodd, C.K., and D.E. Scott. 1994. Drift fences encircling breeding sites. *In* W. Heyer, M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, and M.S. Foster (eds.), Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians, pp. 125-130. Smithsonian Institute Press, Washington, DC.

Fitch, K.C. 1998. The herpotofauna of Dunbar Cave State Natural Area, Montgomery County, Tennessee. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Gibbons, J.W., D.E. Scott, T.J. Ryan, K.A. Buhlmann, T.D. Tuberville, B. Metts, J.L. Greene, T.M. Mills, Y.A. Leiden, S.M. Poppy, and C.T. Winne. 2000. The global decline of reptiles, deja' vu amphibians. Biological Science 50:653-666.

Gibbons, J.W., and P.W. Stangel. 1999. Conserving amphibians and reptiles in the new millennium. *In* Proceedings of the Partners in Amphibian and Reptile Conservation (PARC) Conference. Atlanta, GA, Aiken, SC: Savannah River Ecology Laboratory. Herp Outreach Publication No. 2.

Marsh, D.M., and M.A. Goicochea. 2003. Monitoring terrestrial salamanders: Biases

caused by intense sampling and choice of cover objects. Journal of Herpetology 37:460-466.

Monti, L., M. Hunter, Jr., and J. Witham. 2000. An evaluation of the artificial cover object (ACO) method for monitoring populations of the Redback Salamander *Plethodon cinerus*. Journal of Herpetology 34:624-629.

Mount, R.H. 1975. The Reptiles and Amphibians of Alabama. University of Alabama, Tuscaloosa, Alabama.

National Park Service. 2003a. Statement of Work: Inventory of Herpetofauna for 1 park in the Cumberland Piedmont Network. National Park Service, unpublished document.

National Park Service. 2003b. Fort Donelson National Battlefield. http://www.nps.gov/fodo/pphtml/nature.html. Accessed 12 November 2003.

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C., U.S.A.

Quarterman, E. and R.L. Powell. 1978. Potential ecological/geological natural landmarks on the Interior Low Plateaus. U.S. Department of the Interior, NPS.

Redmond, W.H., A.F. Scott, and D. Roberts. 1982. Comments on the distribution of *Ambystoma talpoideum* (Holbrook) in Tennessee. Herpetological Review 13 (3):83-85.

Rozelle, C.A. 1999. Seasonal activity of reptiles at a woodland and old-field ponds in Land Between The Lakes: results after seven years of data collection. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Rozelle, C.A. and A.F. Scott. 1995. A herpetofaunal survey of Shelton Ferry Wetland,

Montgomery County, Tennessee. Final Report, Contract ID-4-05231-4-00, Tennessee Wildlife Resources Agency, Nashville, Tennessee.

Ryan, T.J., T. Philippi, Y.A. Leiden, M.E. Dorcas, T.B. Wigley, and J.W. Gibbons. 2002. Monitoring herpetofauna in a managed forest landscape: effects of habitat types and census techniques. Forest Ecology and Management 167:83-90.

Scott, A.F. 1967. A survey of the herpetofauna of Montgomery County, Tennessee. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Scott, A.F. 1991. The herpetofauna of Barnett Woods Natural Area, Montgomery County, Tennessee. Journal of the Tennessee Academy of Science 66 (2):85-88.

Scott, A.F. 2002. Amphibians and reptiles in Land Between the Lakes. Pp. 401-417. In E.W. Chester and J.S. Fralish (Eds.), Land Between The Lakes, Kentucky and Tennessee: Four Decades of Tennessee Valley Authority Stewardship. Miscellaneous Publication No. 16, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee.

Scott, A.F., D. Van Norman, and R. Rich. 1984. Dawson Spring Seep Swamp: site of some significant new amphibian records. Transactions of the Kentucky Academy of Science 45 (3-4):157-158.

Scott, A.F. and D.H. Snyder. 1968. The amphibians and reptiles of Montgomery County, Tennessee. Journal of Tennessee Academy of Science 43:79-84.

Scott, A.F., E.W. Chester, and D.H. Snyder. 1980. A study of selected potential natural areas inthe lower Cumberland River basin of Tennessee. Unpublished report submitted to Tennessee Department of Conservation, Natural Heritage Program, Nashville, Tennessee.

Scott, A.F., G.A. Schuster, D. Mullen, B. Cushing, and G. Murphy. 1995. Rare and endangered animal species survey. Fort Campbell Military Reservation, Kentucky and Tennessee. Unpublished report submitted to the Tennessee Field Office, The Nature Conservancy, Nashville, Tennessee.

Scott, A.F., S. Sutton, and S. Williamson. 2000. New county records of salamanders, frogs, toads, and turtles from the Western Highland Rim of central Tennessee. Herpetological Review 31 (2):117-118.

Scott, A.F. and S. Williamson. 1999. The herpetofauna of Haynes Bottom Wildlife Management Area: A Tennessee Wildlife Resources Property in Montgomery County, Tennessee. Unpublished report submitted to Tennessee Wildlife Resources Agency, Nashville, Tennessee.

Shaffer, H.B., and J.E. Juterbock. 1994. Night driving. *In* W. Heyer, M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, and M.S. Foster (eds.), Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians, pp. 163-166. Smithsonian Institute Press, Washington, DC.

Snyder, D.H. 1972. Amphibians and Reptiles of Land Between The Lakes. Tennessee Valley Authority, Golden Pond, Kentucky.

Springer, M.E., and J.A. Elder. 1980. Soils of Tennessee. Univ of Tennessee Agricultural Exp. Station Bull. 596. Knoxville, Tennessee.

Southeast Regional Climate Center. 2005. Historical Summaries for Tennessee. http://www.dnr.state.sc.us/water/climate/sercc. Accessed 26 July 2005.

Tennessee Department of Environment and Conservation, Division of Natural Heritage.

2004. A guide to the rare animals of Tennessee. Tennessee Dept. Environ. Conserv., Nashville, Tennessee.

United States Department of Agriculture. 1953. Soil survey of Stewart County, Tennessee. Soil Conservation Service in cooperation with the Tennessee Agricultural Experimental Station and the Tennessee Valley Authority. Washington, District of Columbia.

United States Fish and Wildlife Service. 2005. Threatened and endangered species system (TESS). http://ecos.fws.gov/tess_public/TESSSpeciesReport. Accessed 10 July 2005.

Van Norman, D.E. 1985. The distribution and breeding habitat of the barking treefrog, *Hyla gratiosa* LeConte, in south-central Kentucky and north-central Tennessee. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Van Norman, D.E., and A.F. Scott. 1987. The distribution and breeding habitat of the barking treefrog, *Hyla gratiosa* LeConte, in south-central Kentucky and north-central Tennessee. Journal of the Tennessee Academy of Science 62 (1):7-11.

White, C.M. 1997. Population fluctuation, dispersion, and diel activity of the cave salamander, *Eurycea lucifuga*, in selected Tennessee and Kentucky caves. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Williamson, S. 2001. Geographic distribution, population structure, habitat, and movements of newly discovered population of *Sternotherus minor peltifer* (stripe-necked musk turtle) inthe lower Tennessee River drainage of western Middle Tennessee. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

Zirkle, G.E. 1993. A survey of the herpetofauna of Fort Campbell Military Reservation,

Kentucky and Tennessee. M.S. thesis, Austin Peay State University, Clarksville, Tennessee.

# APPENDIX

## Fort Donelson National Battlefield Herpetological Inventory
## Field Data Sheet for Plots and Special Habitats

Plot/Site Code_____ Date_____ Observer(s)_____ Page 1 of ___

Time start_____ Time End_____ Total _____

Current Weather:
**Precipitation**: None, Light, Moderate, Heavy; Rain, Snow;
**Wind**: Calm, Light, Moderate, Gusty, Strong
**Sky**: Clear, Partly Cloudy, Mostly Cloudy, Overcast
Notes:_____

Previous Weather (last 24 hours)_____

### Specimen Records

| Species | Coordinates (UTM) | Sex | Age | Repro Cond | SVL (mm) | Mass (g) | Temp (C) | | | pH | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Air | $H_2O$ | Soil | $H_2O$ | Soil | |
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Figure A-1. Data entry sheet for Fort Donelson herpetofauna inventory.

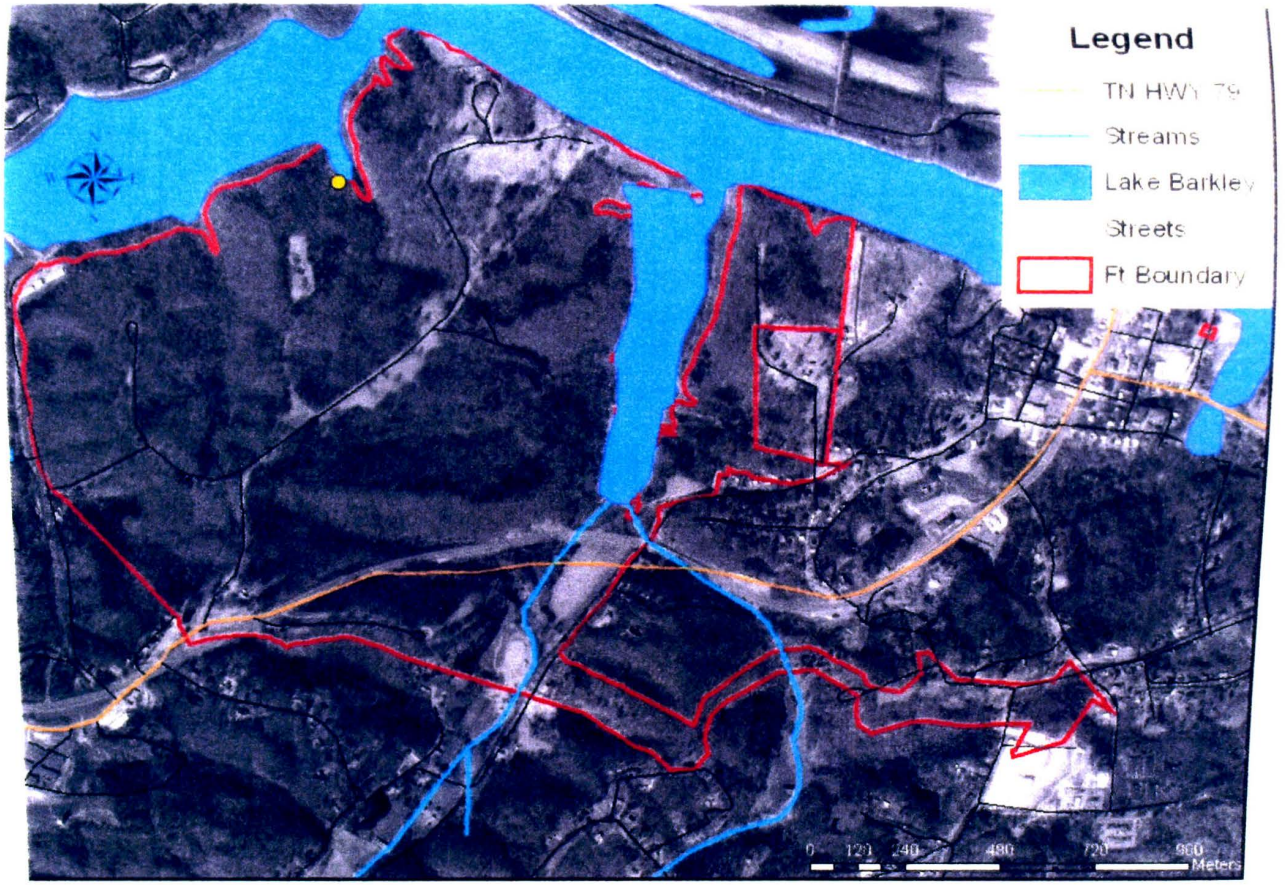


Figure A-2. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Acris crepitans* was documented, January 2004 to June 2005.

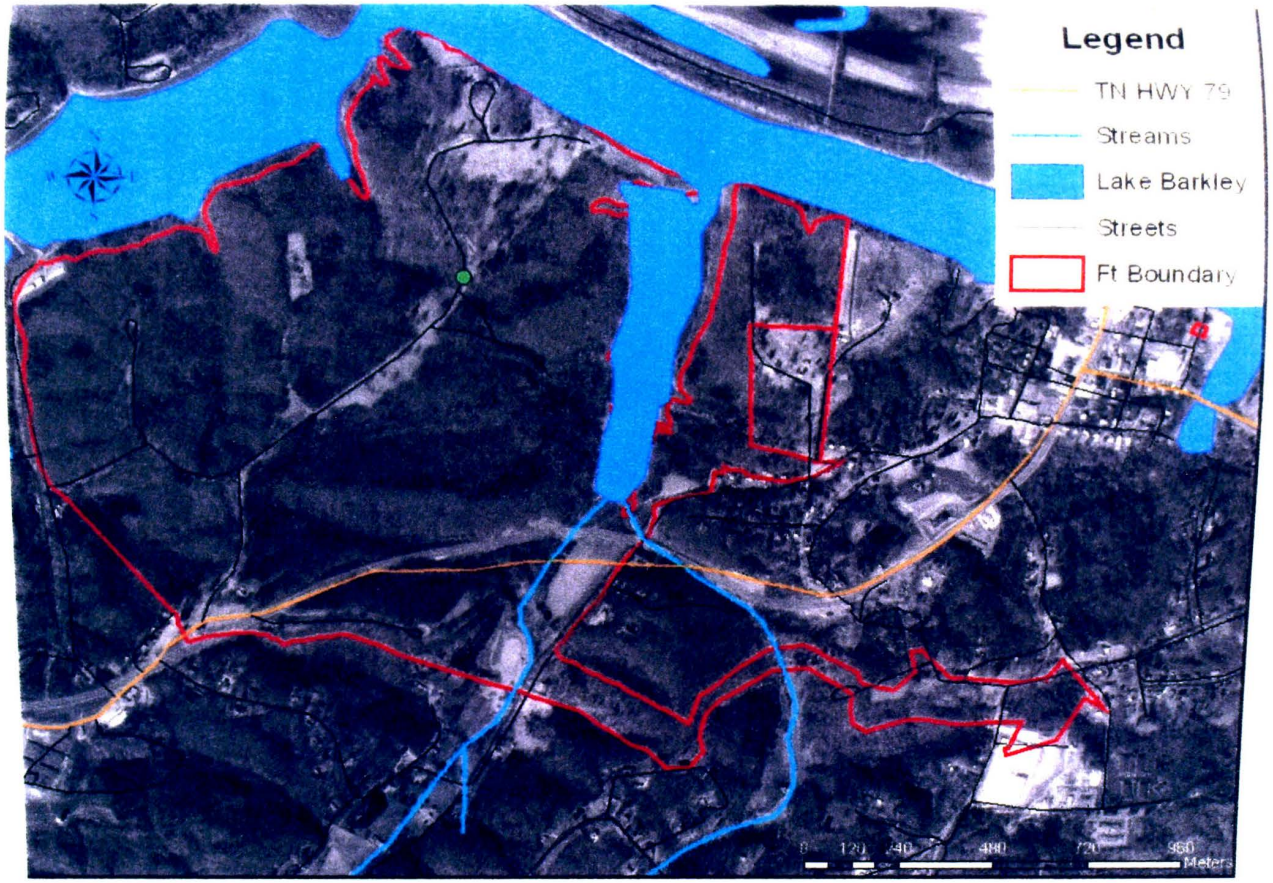


Figure A-3. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Agkistrodon contortrix* was documented, January 2004 to June 2005.

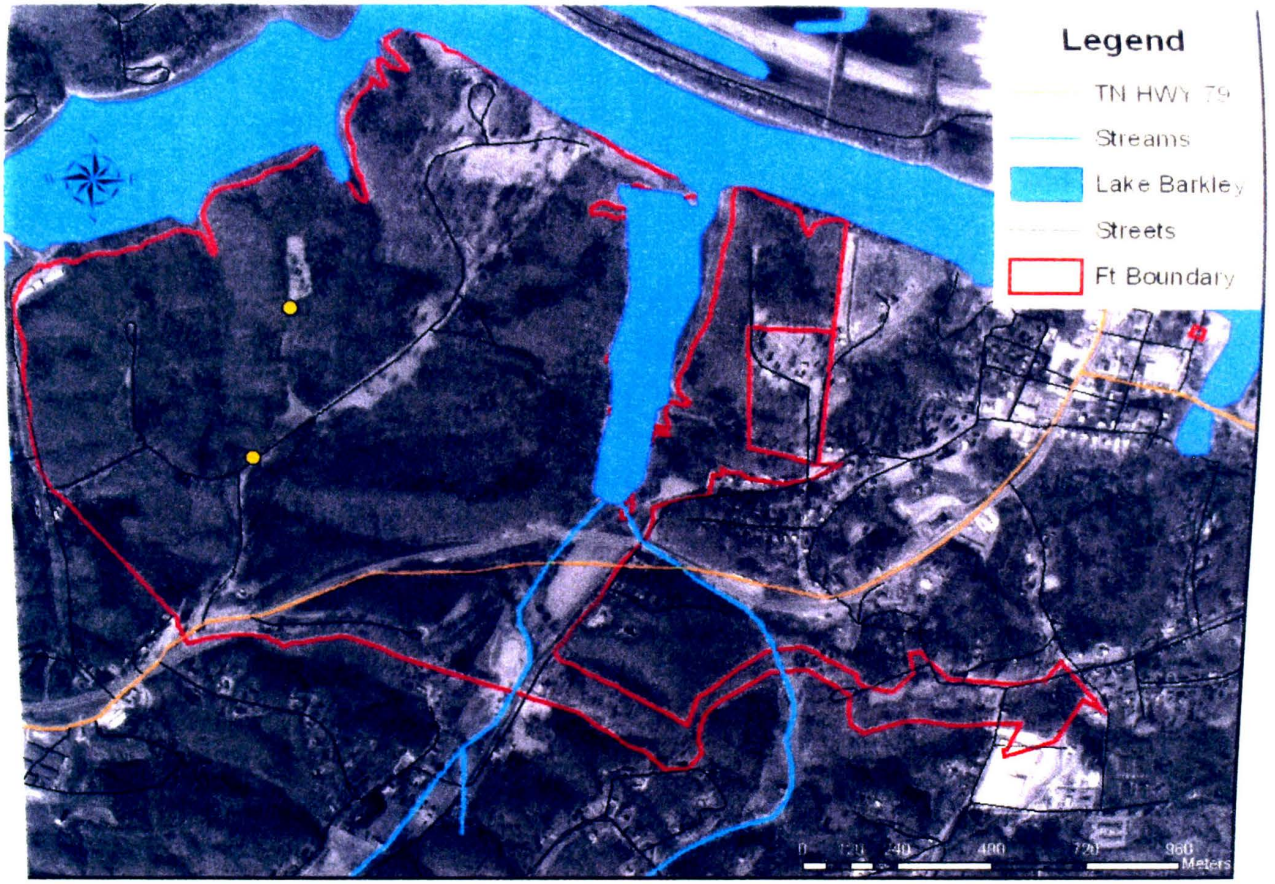


Figure A- 4. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Ambystoma maculatum* was documented, January 2004 to June 2005.

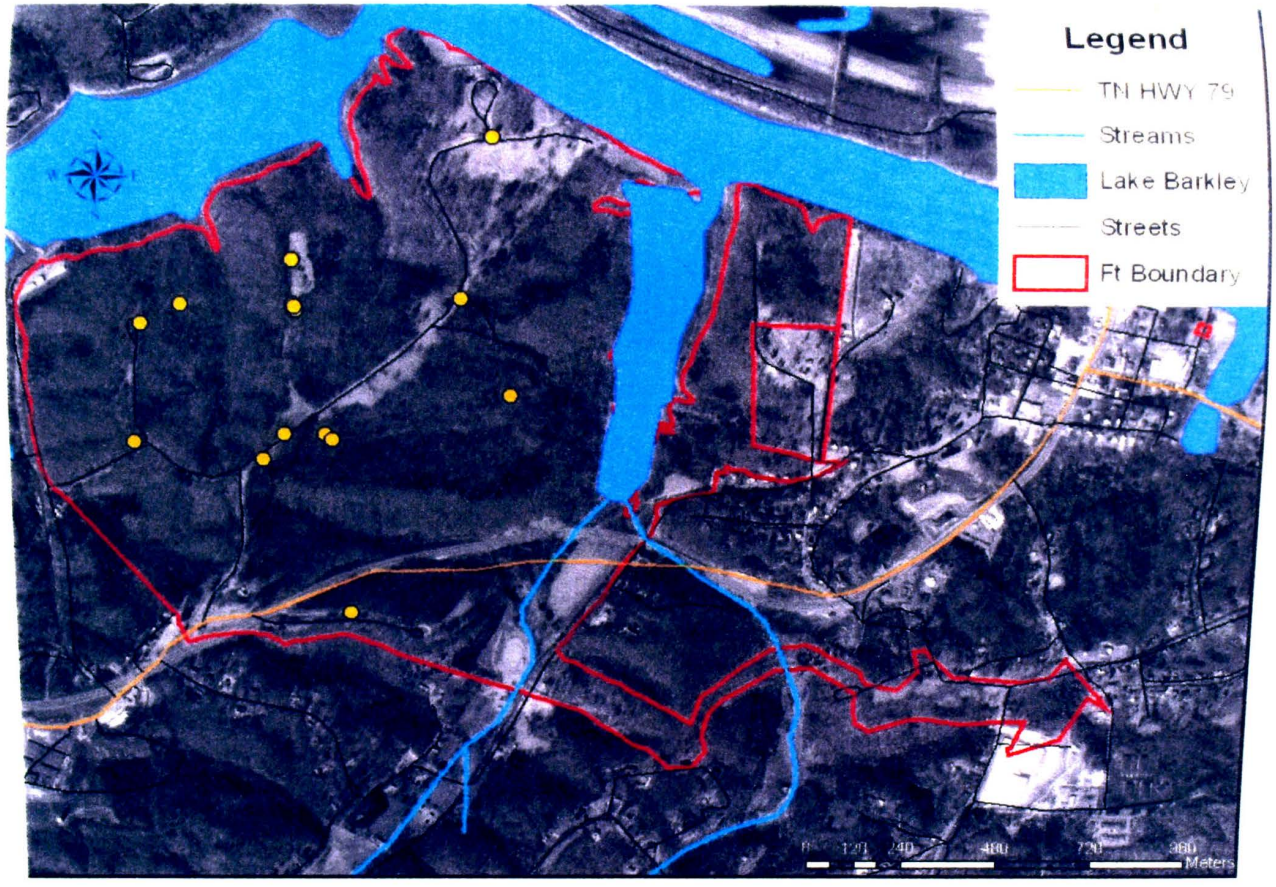


Figure A-5. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Bufo americanus* was documented, January 2004 to June 2005.

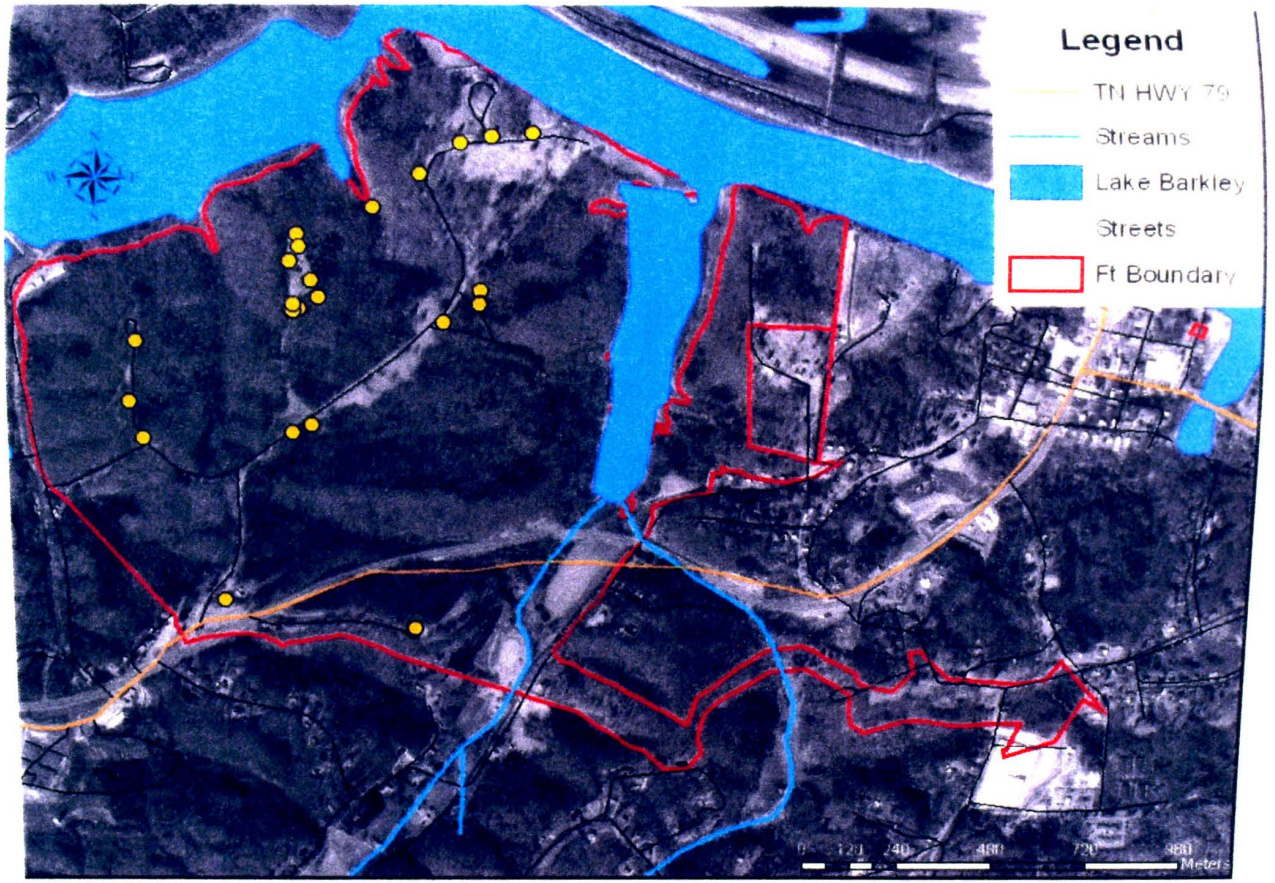


Figure A-6. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Bufo fowleri* was documented, January 2004 to June 2005.

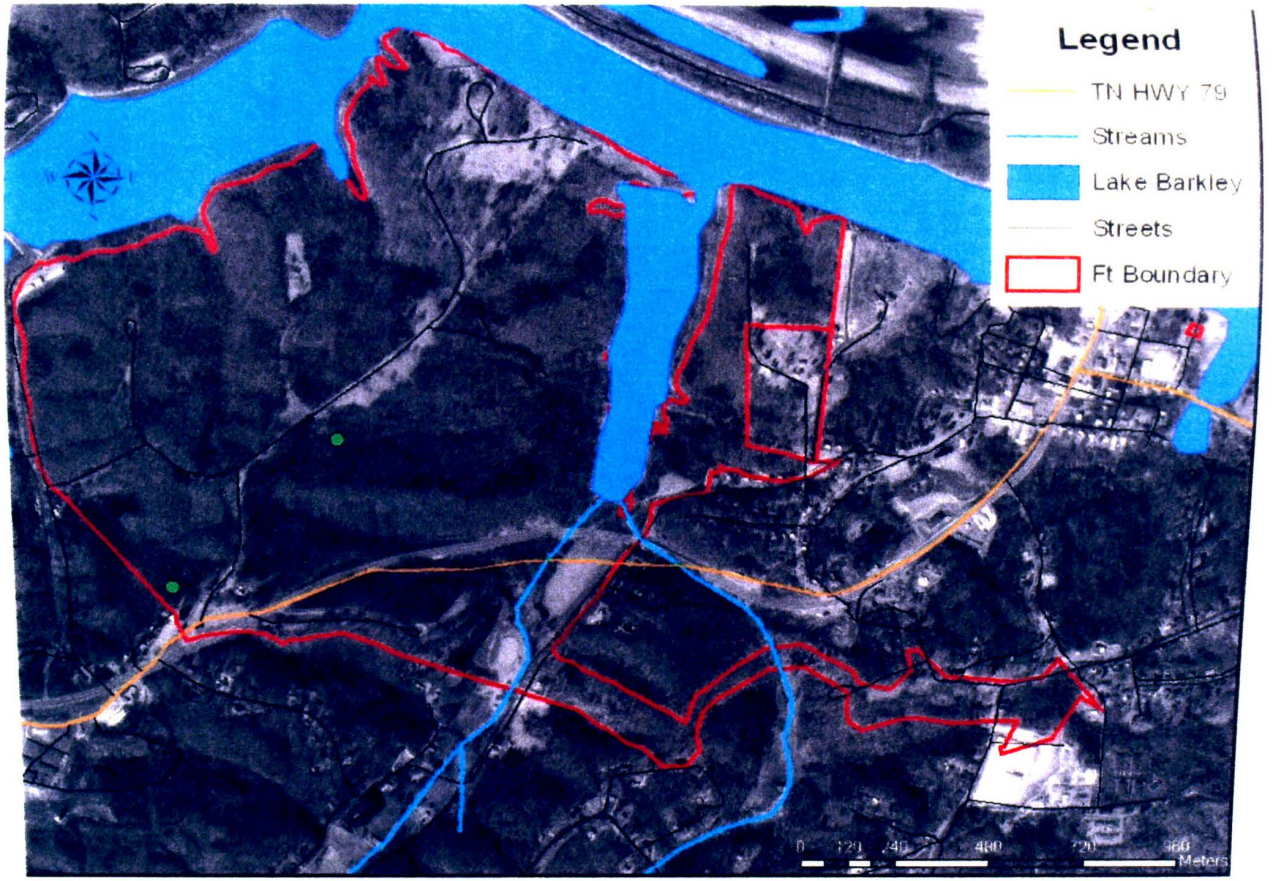


Figure A-7. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Carphophis amoenus* was documented, January 2004 to June 2005.

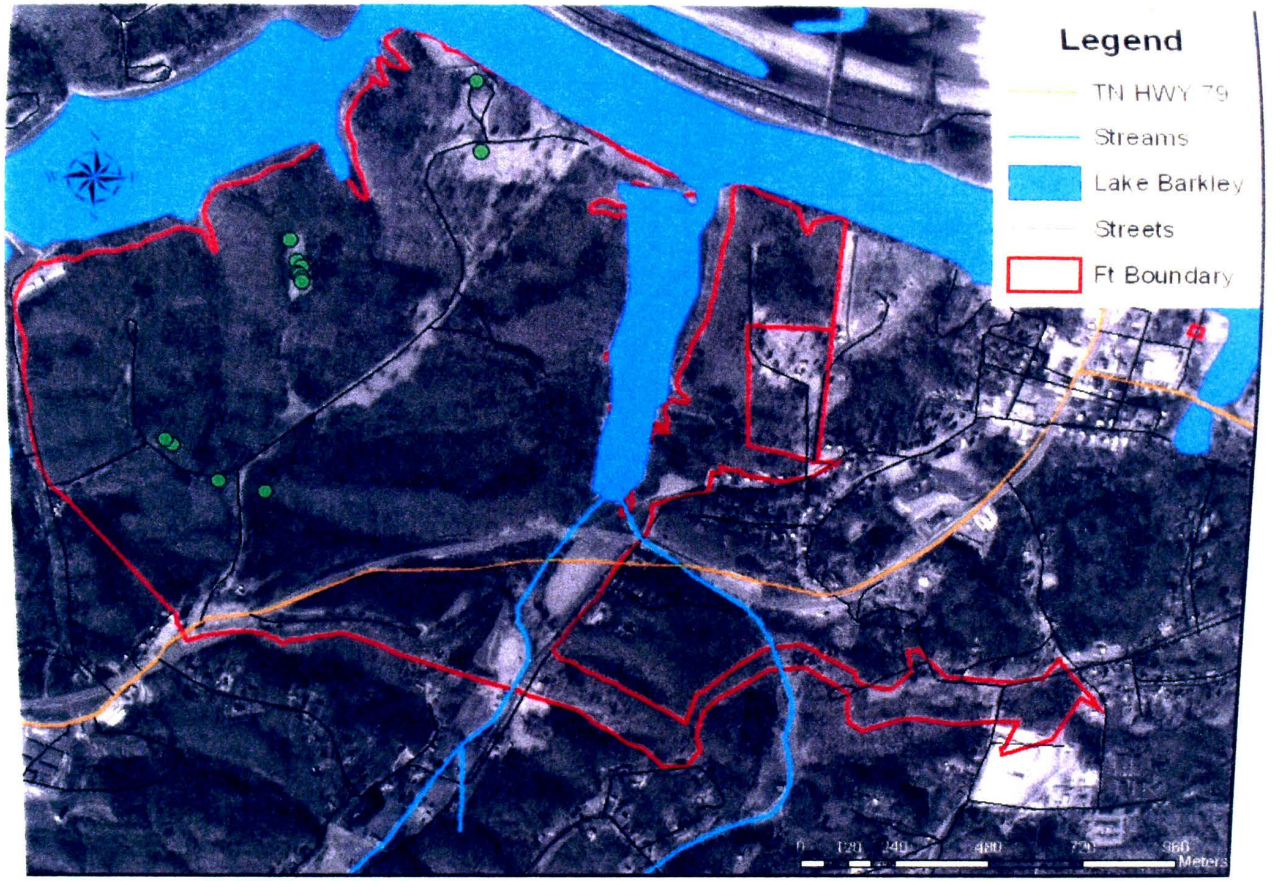


Figure A-8. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Coluber constrictor* was documented, January 2004 to June 2005.

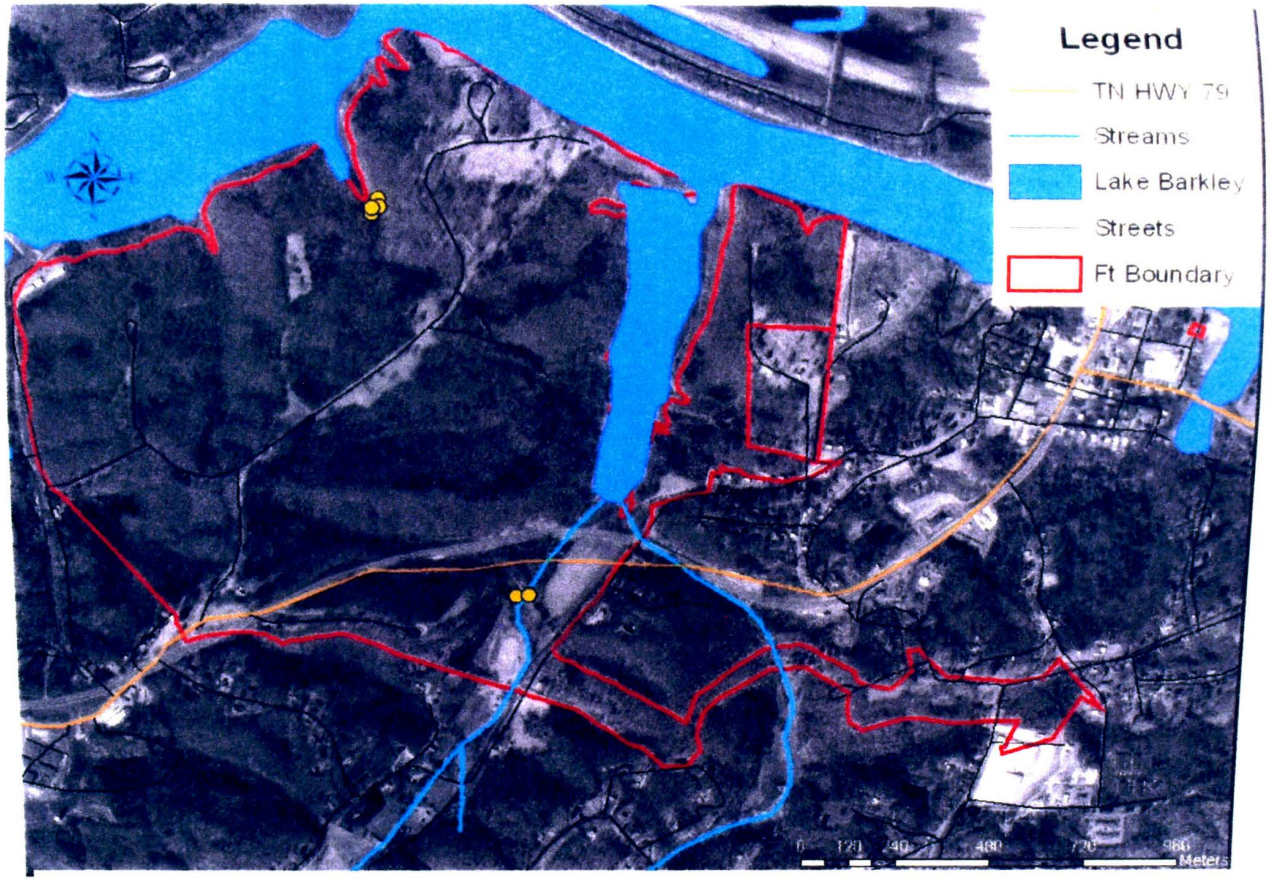


Figure A-9. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Desmognathus conanti* was documented, January 2004 to June 2005.

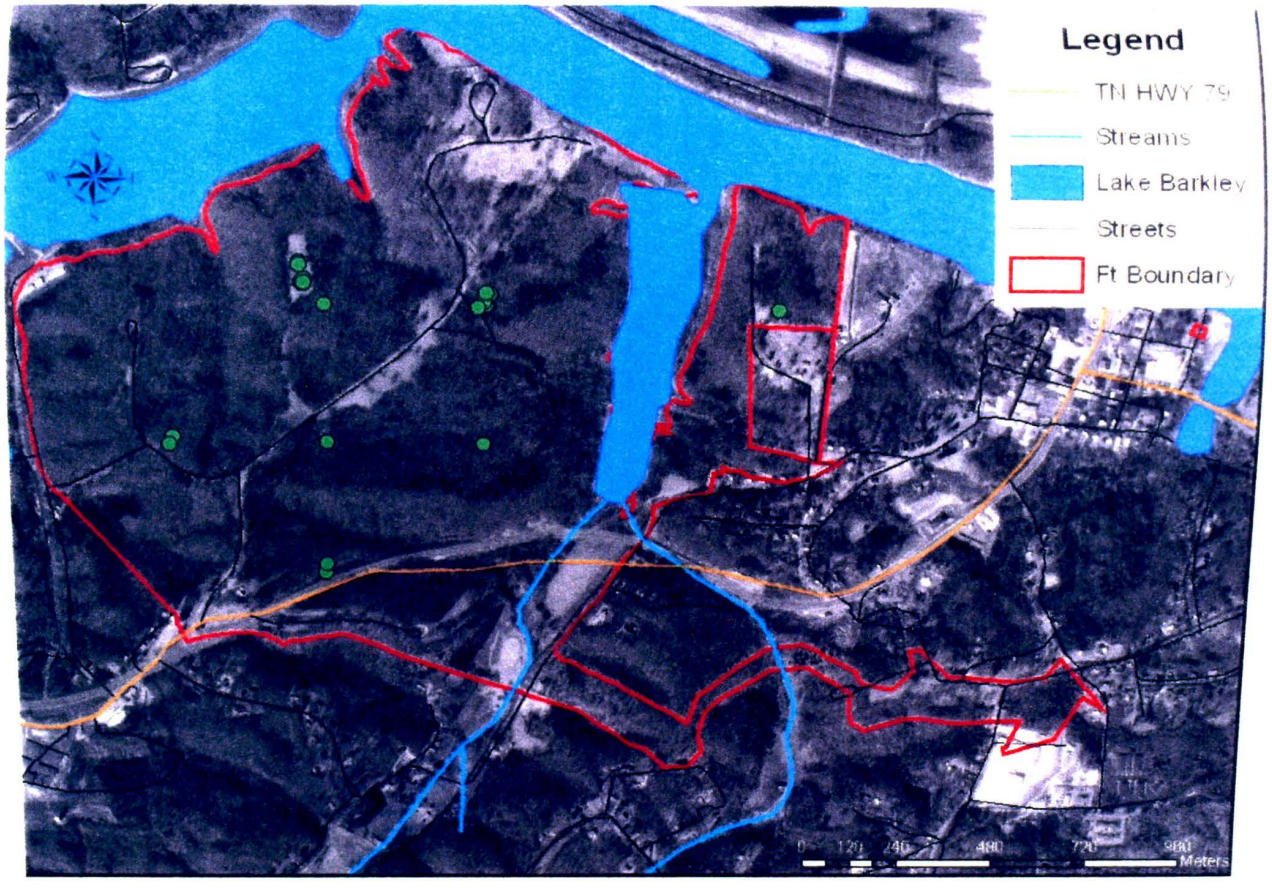


Figure A-10. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Diadophis punctatus* was documented, January 2004 to June 2005.

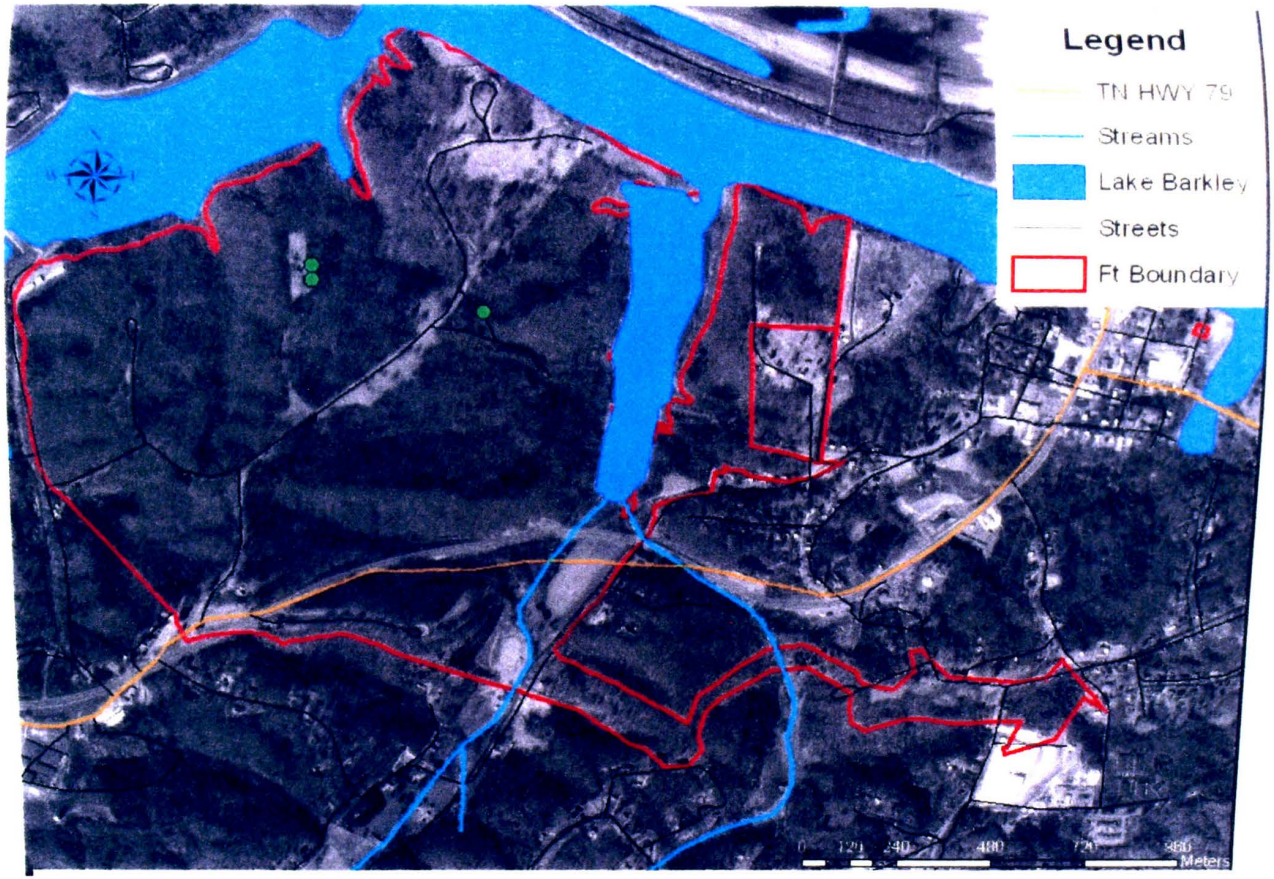


Figure A-11. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Eumeces fasciatus* was documented, January 2004 to June 2005.

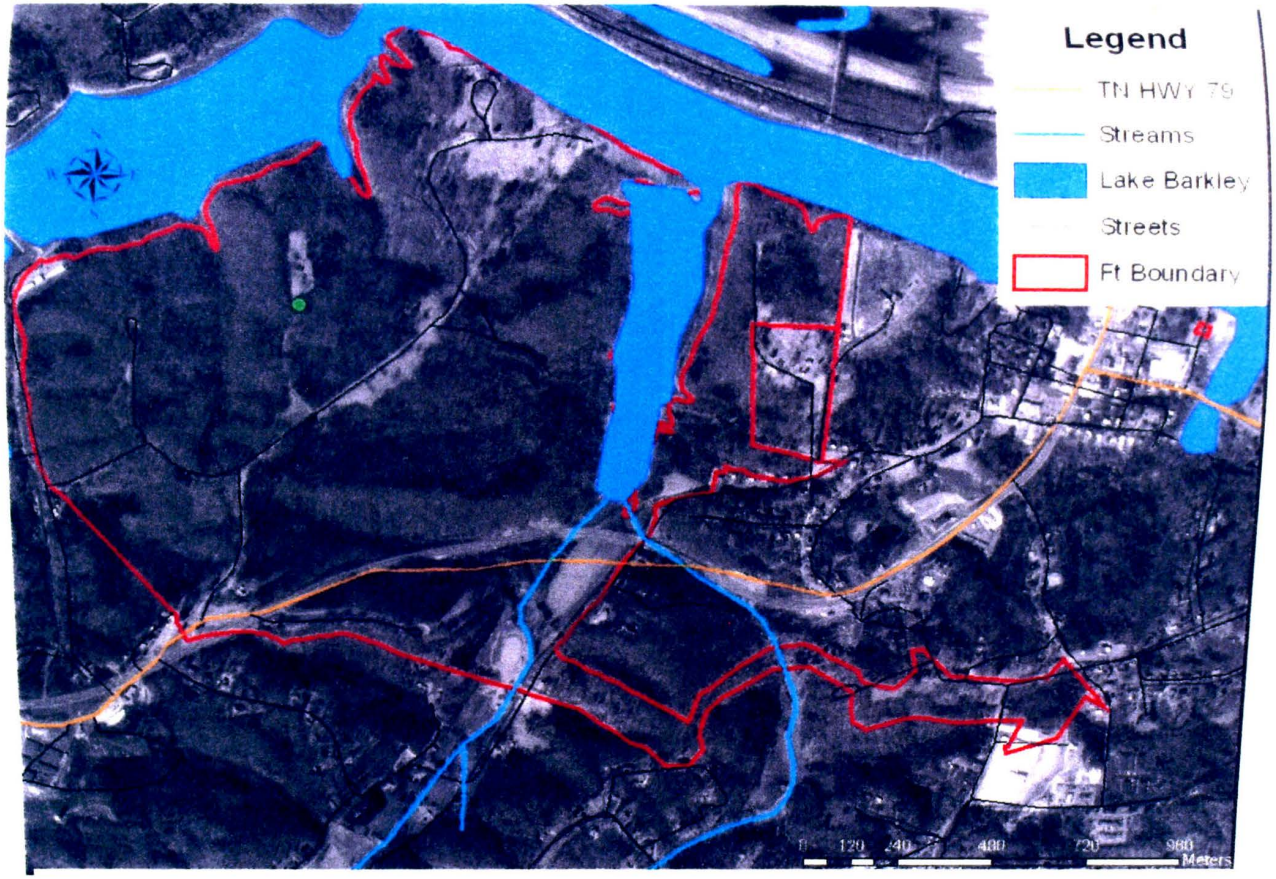


Figure A-12. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Eumeces laticeps* was documented, January 2004 to June 2005.

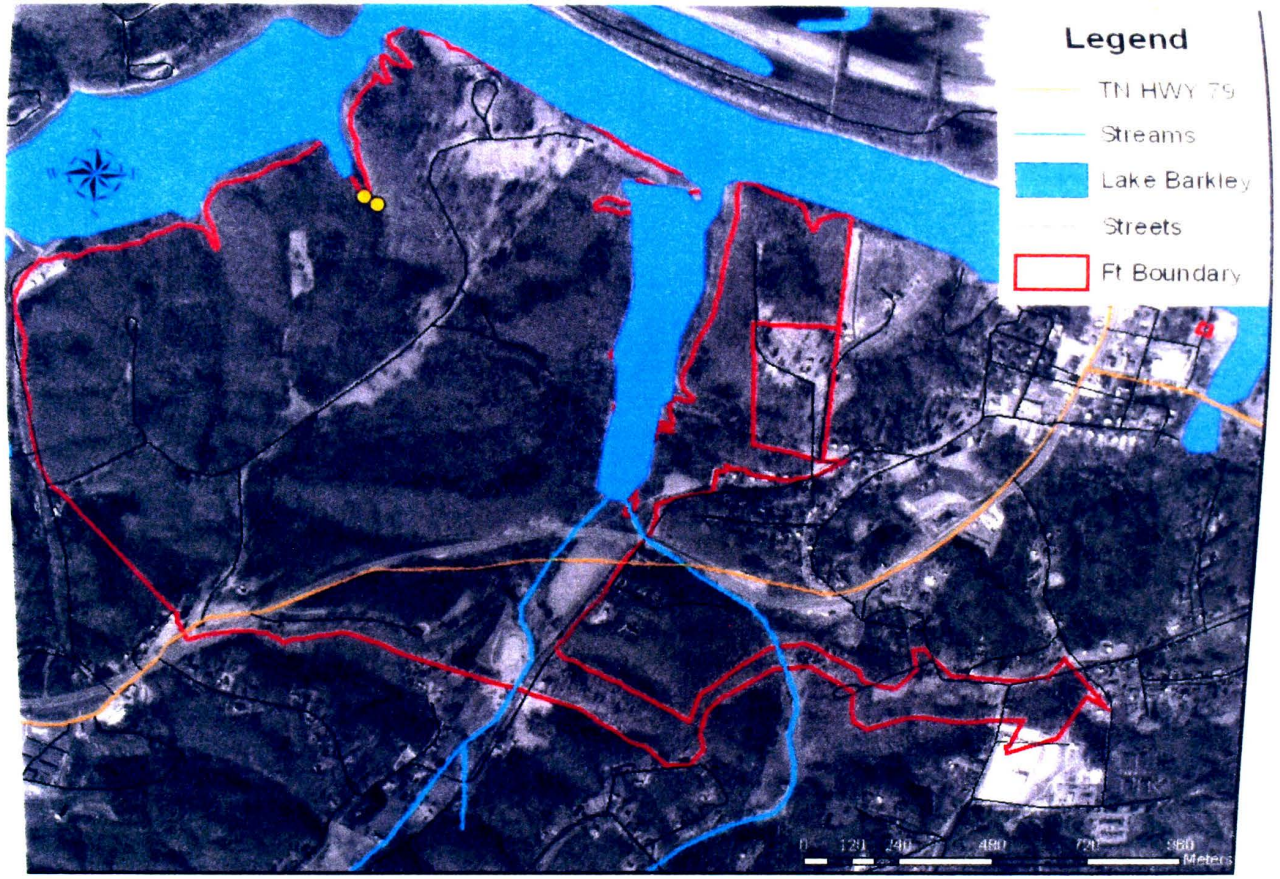


Figure A-13. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Eurycea cirrigera* was documented, January 2004 to June 2005.

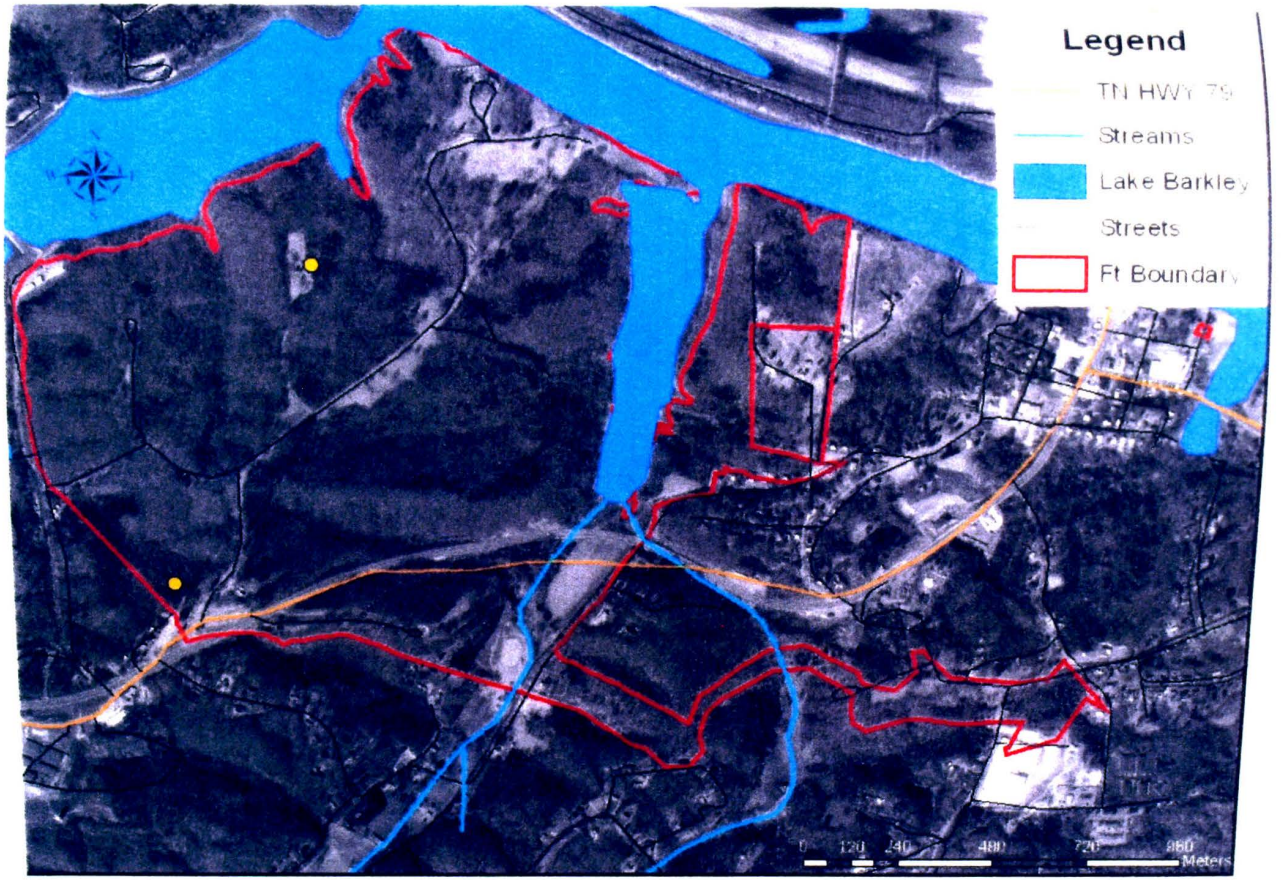


Figure A-14. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Eurycea lucifuga* was documented, January 2004 to June 2005.

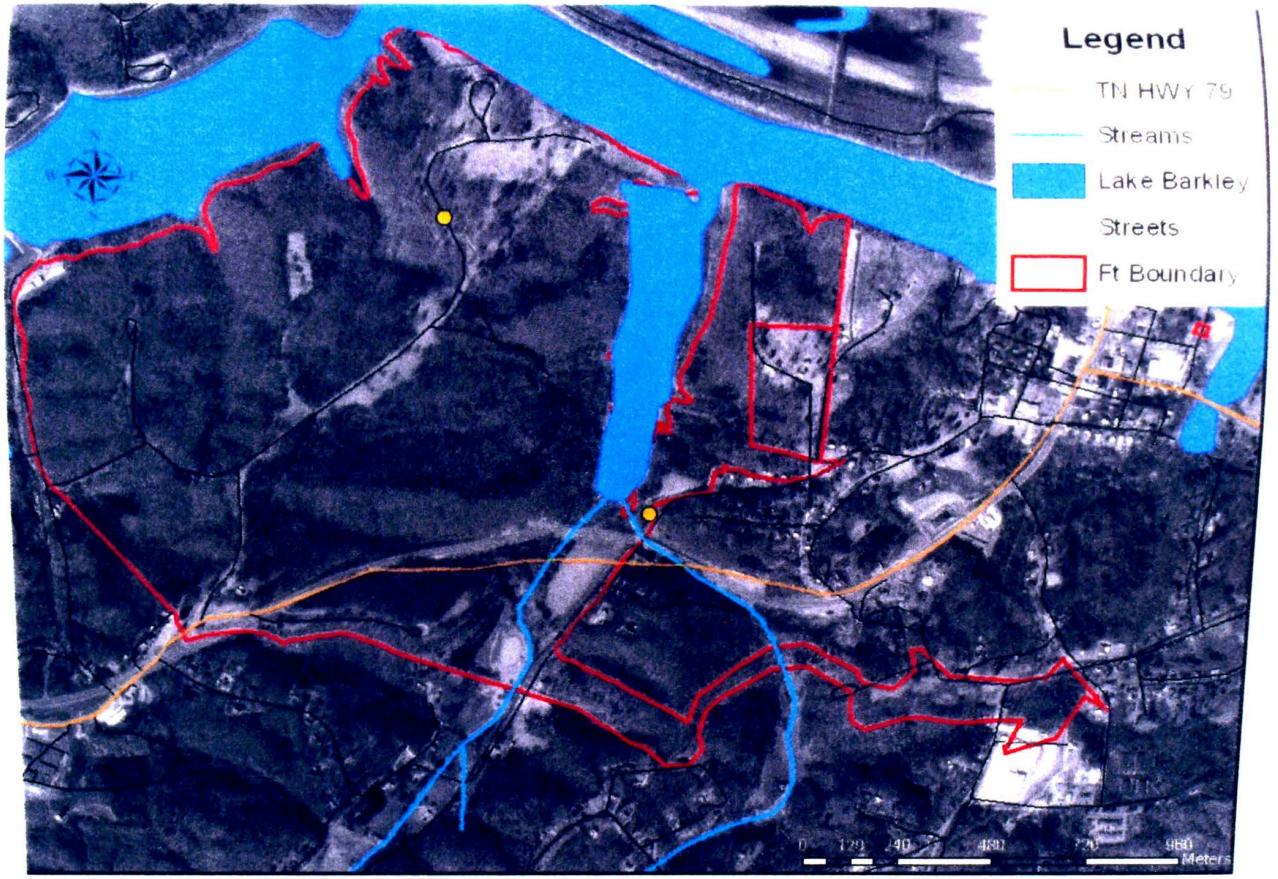


Figure A-15. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Hyla spp.*, gray treefrog, was documented, January 2004 to June 2005.

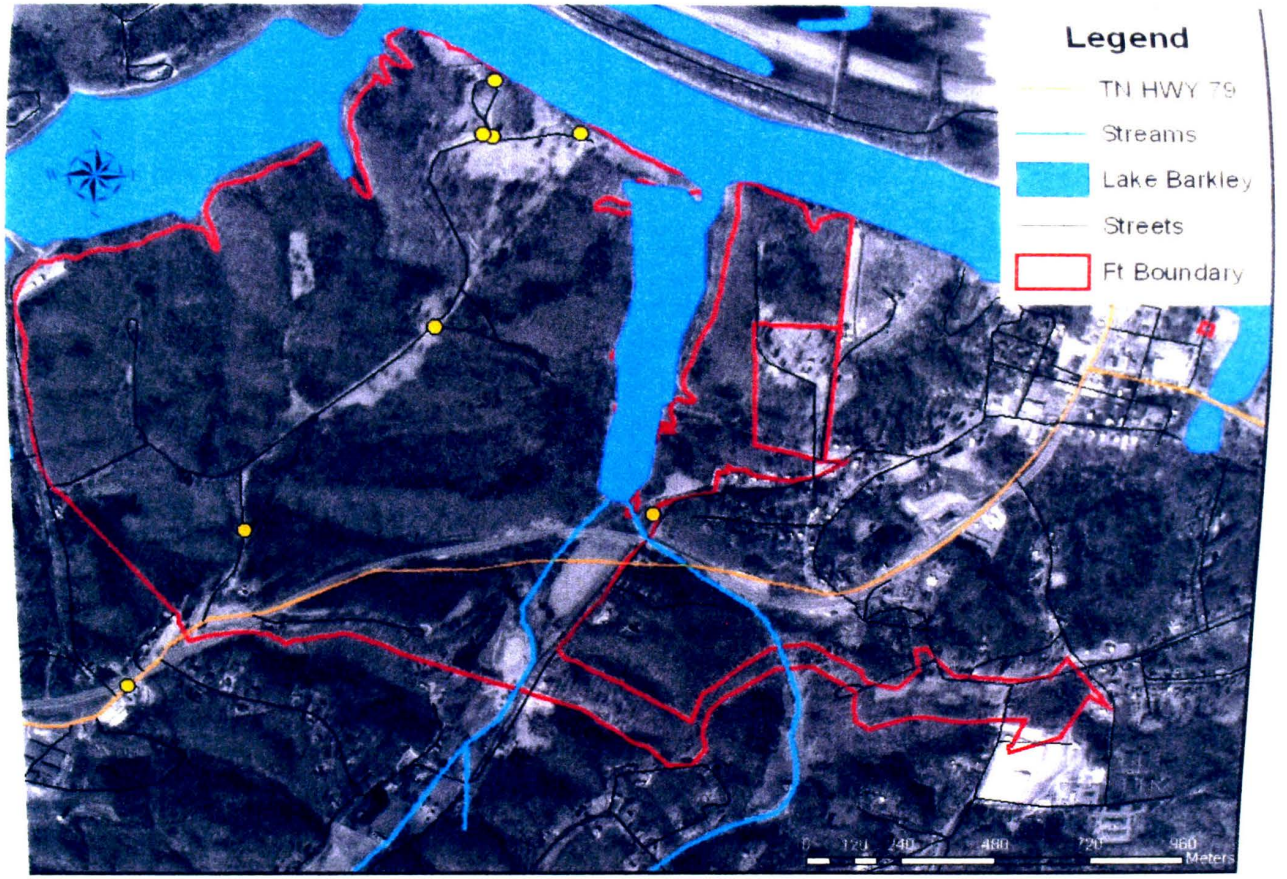


Figure A-16. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Hyla cinerea* was documented, January 2004 to June 2005.

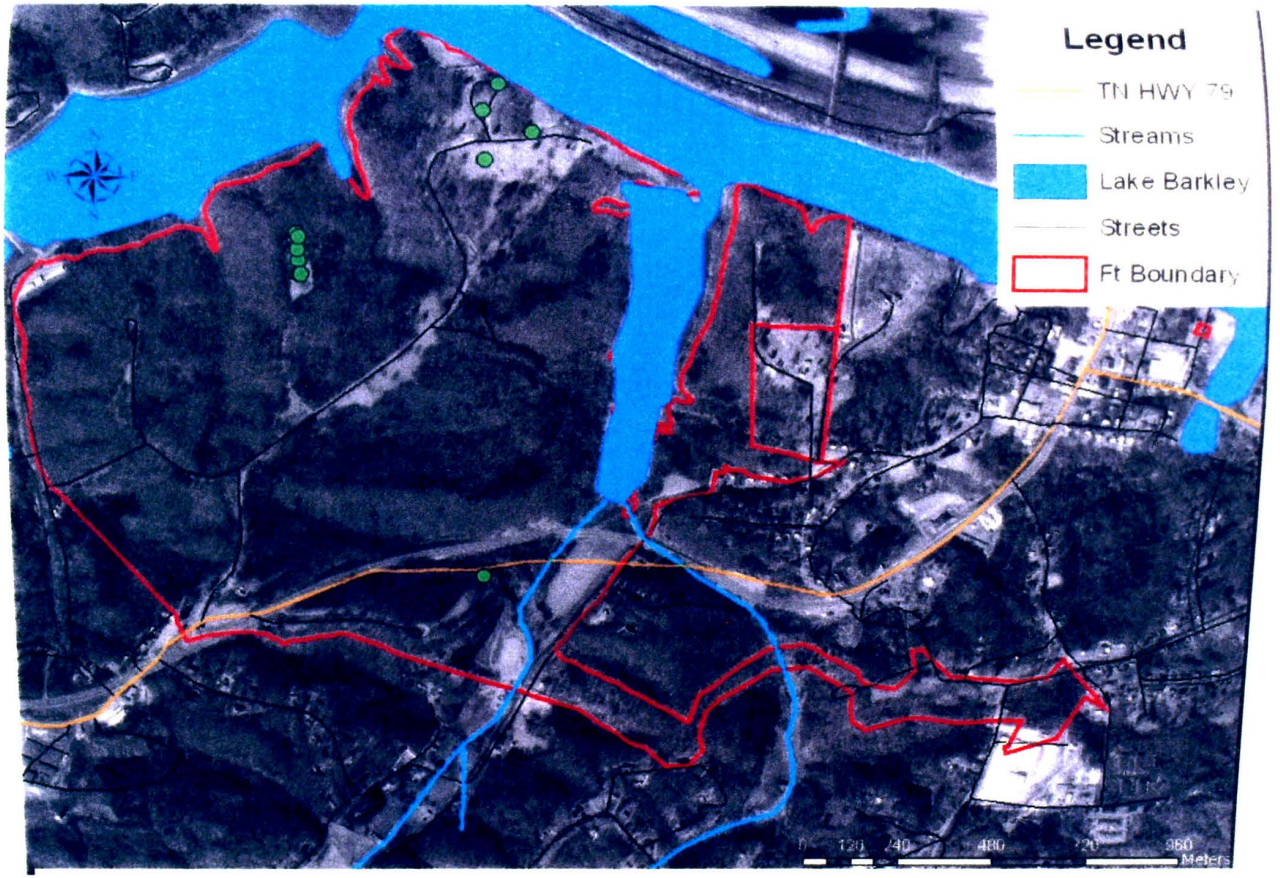


Figure A-17. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Lampropeltis getula nigra* was documented, January 2004 to June 2005.

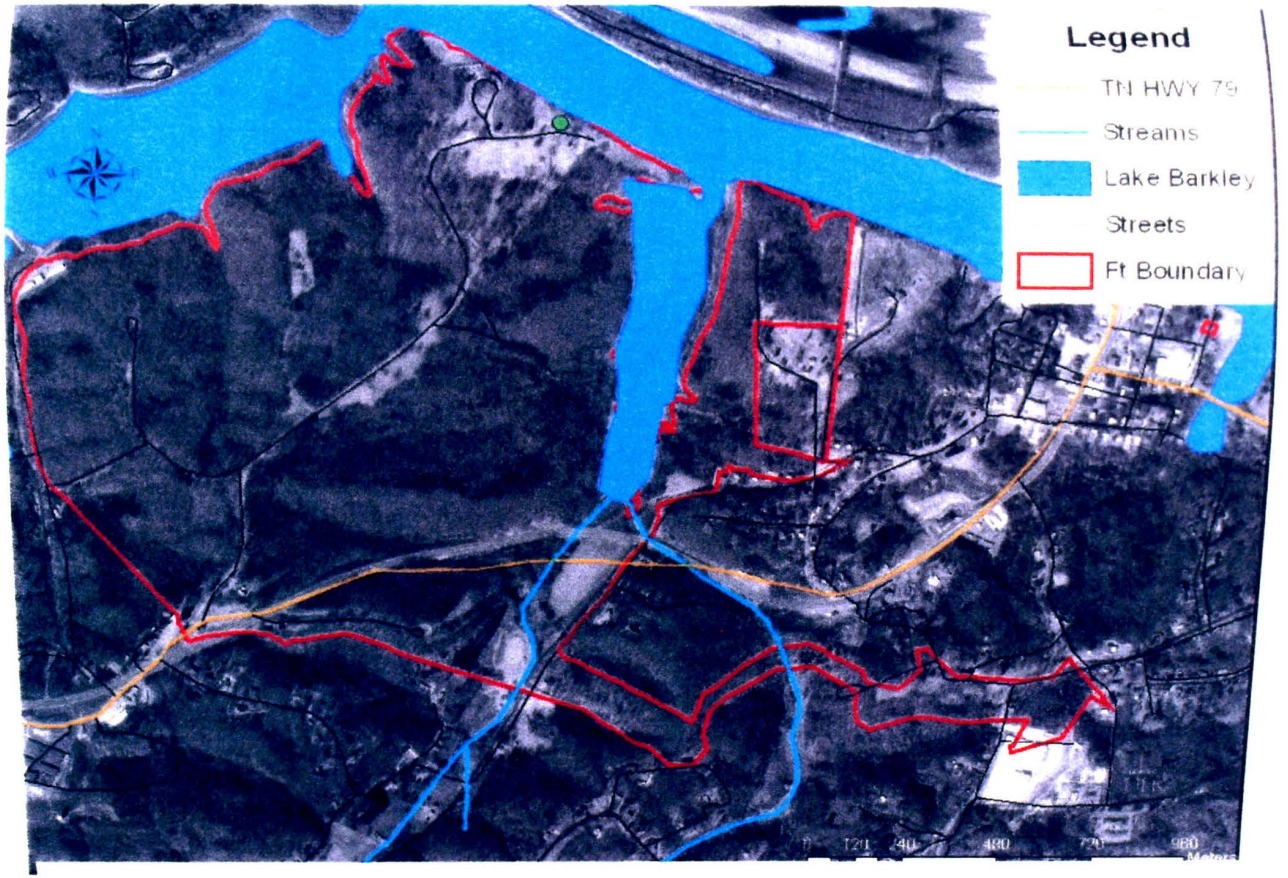


Figure A-18. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Lampropeltis triangultum* was documented, January 2004 to June 2005.

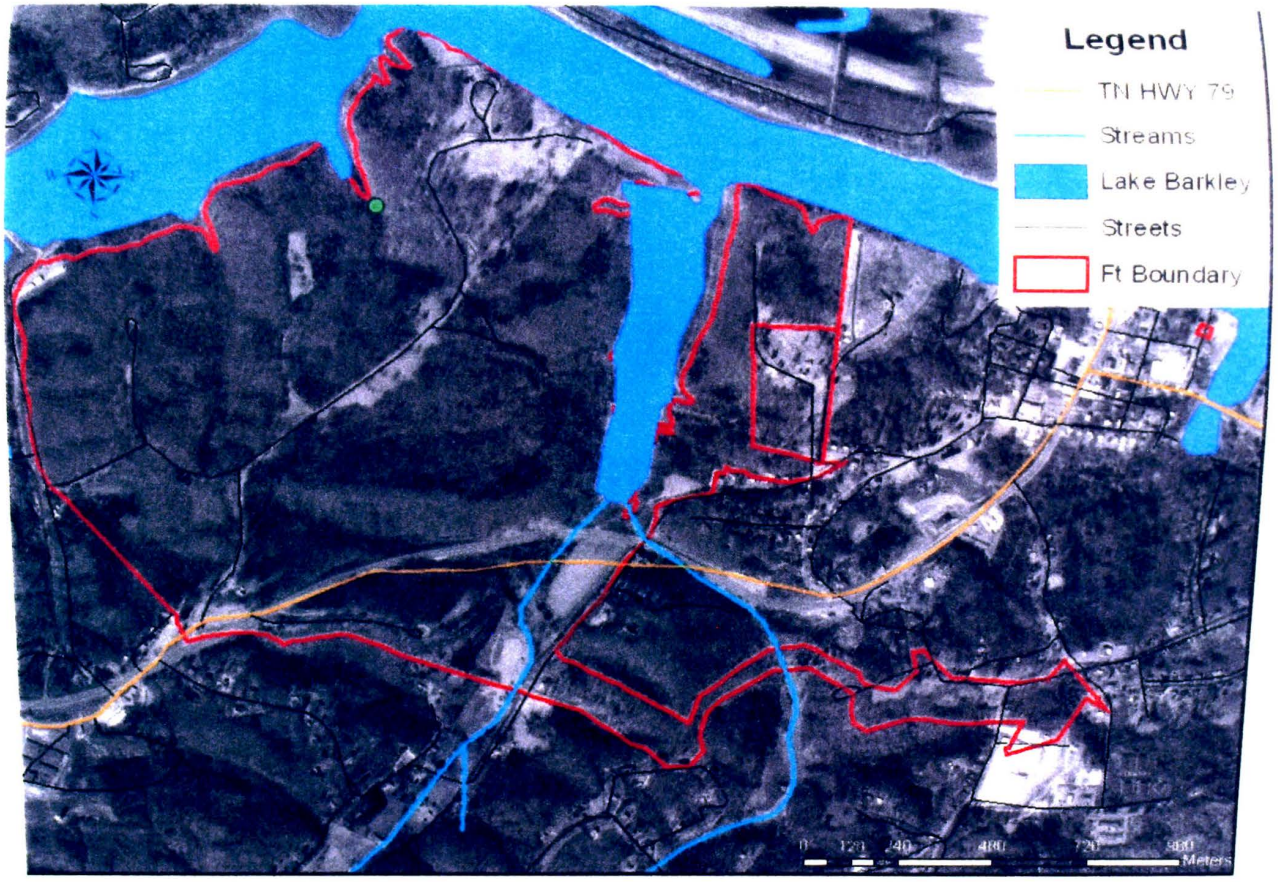


Figure A-19. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Nerodia sipedon* was documented, January 2004 to June 2005.

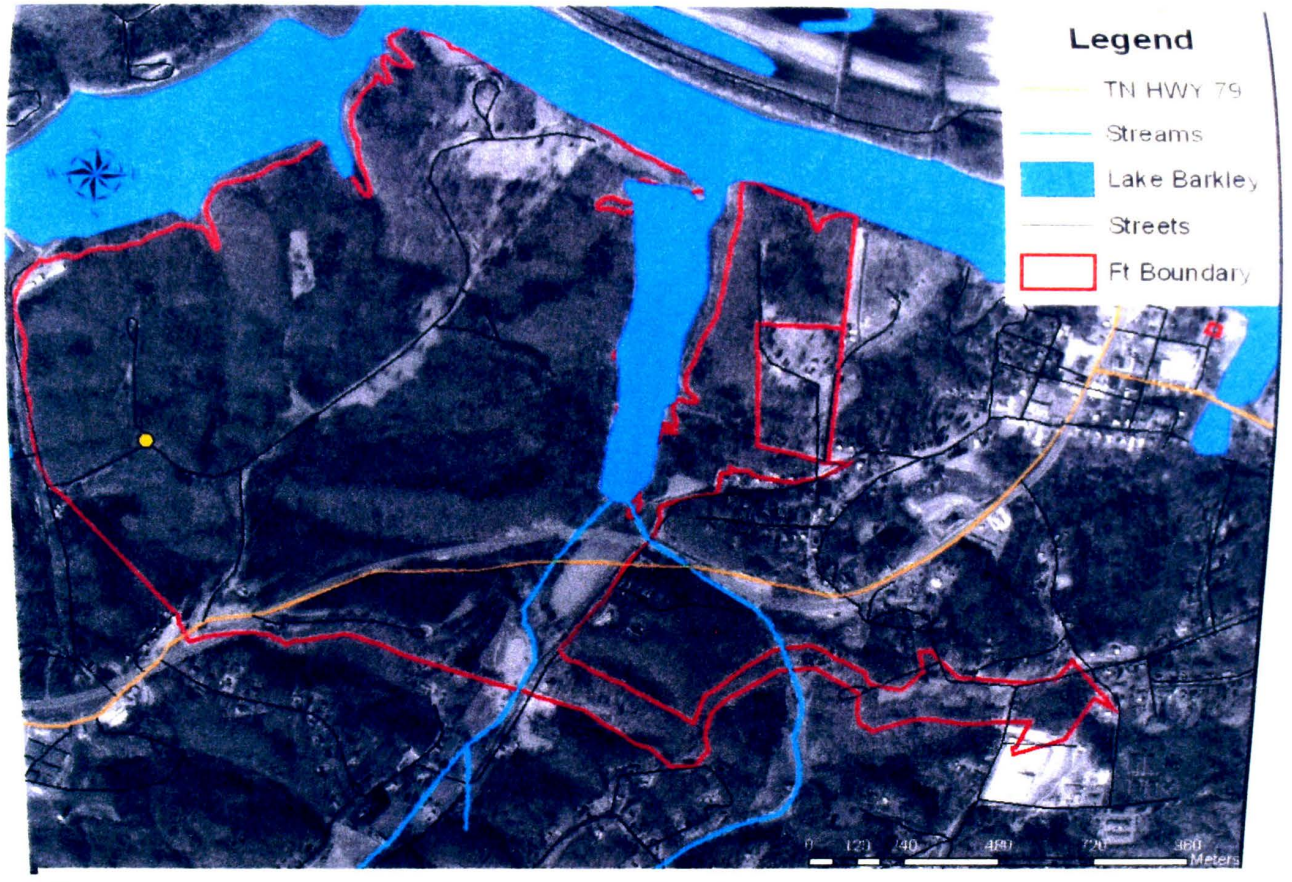


Figure A-20. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Notophthalamus viridescens* was documented, January 2004 to June 2005.

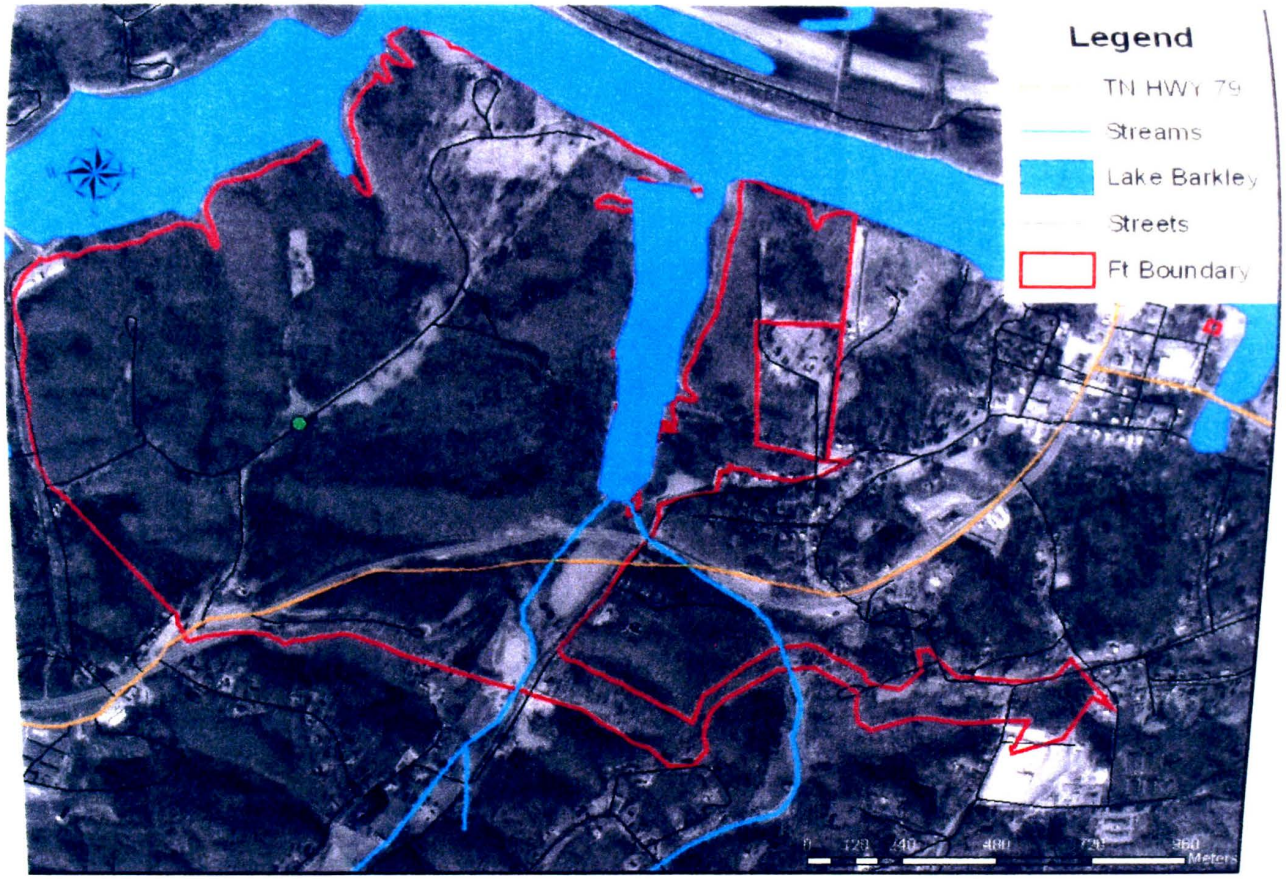


Figure A-21. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Opheodrys aestuvus* was documented, January 2004 to June 2005.

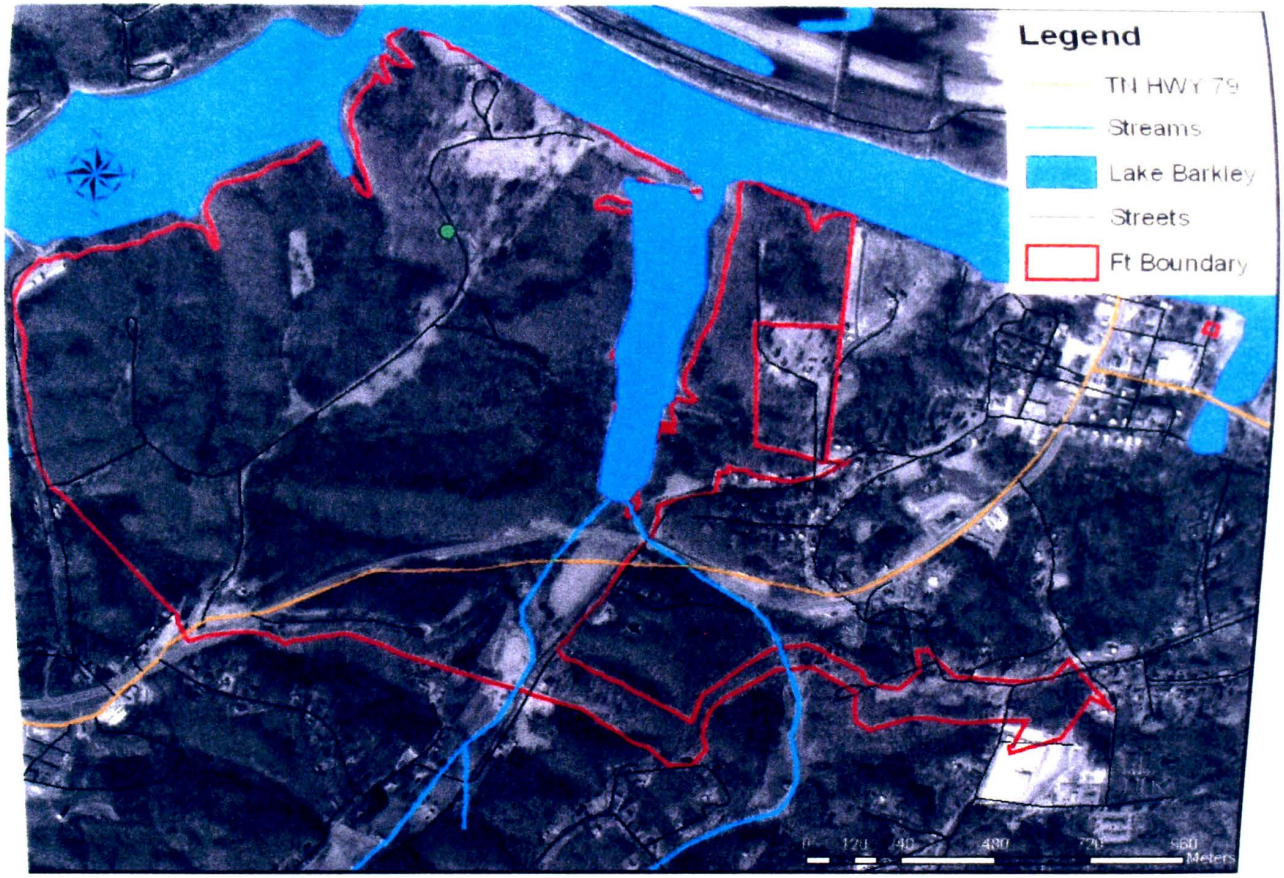


Figure A-22. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Pantherophis spiloides* was documented, January 2004 to June 2005.

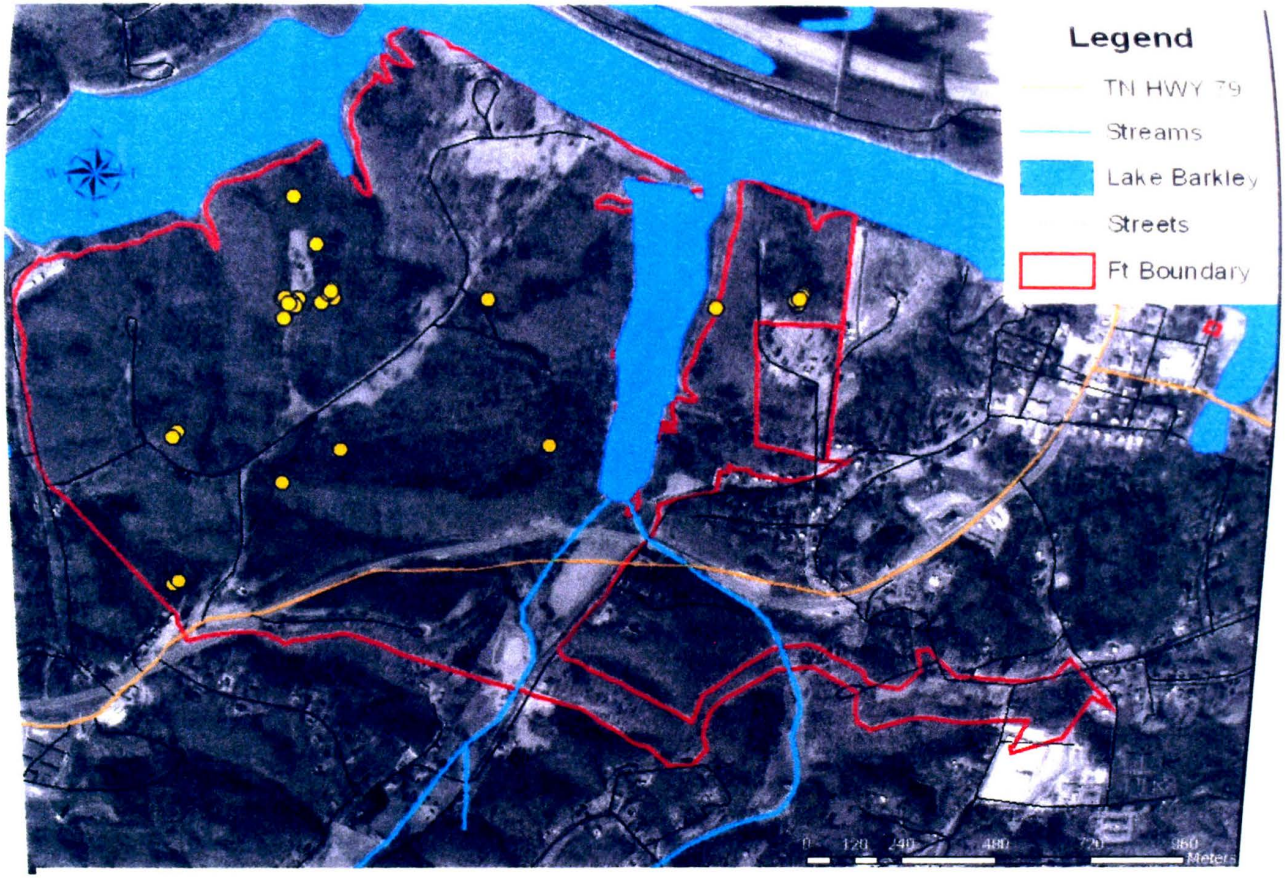


Figure A-23. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Plethodon dorsalis* was documented, January 2004 to June 2005.

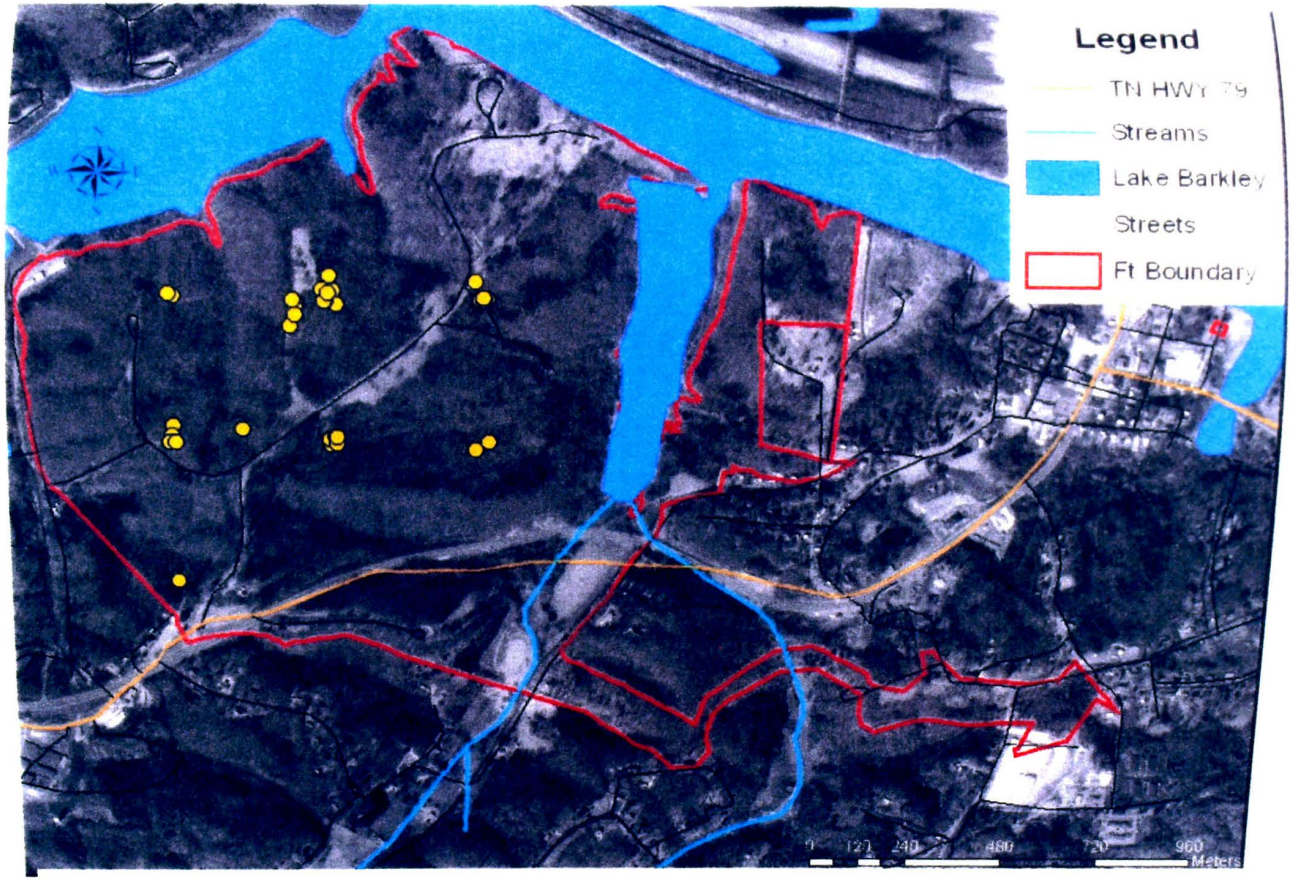


Figure A-24. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Plethodon glutinosus* was documented, January 2004 to June 2005.

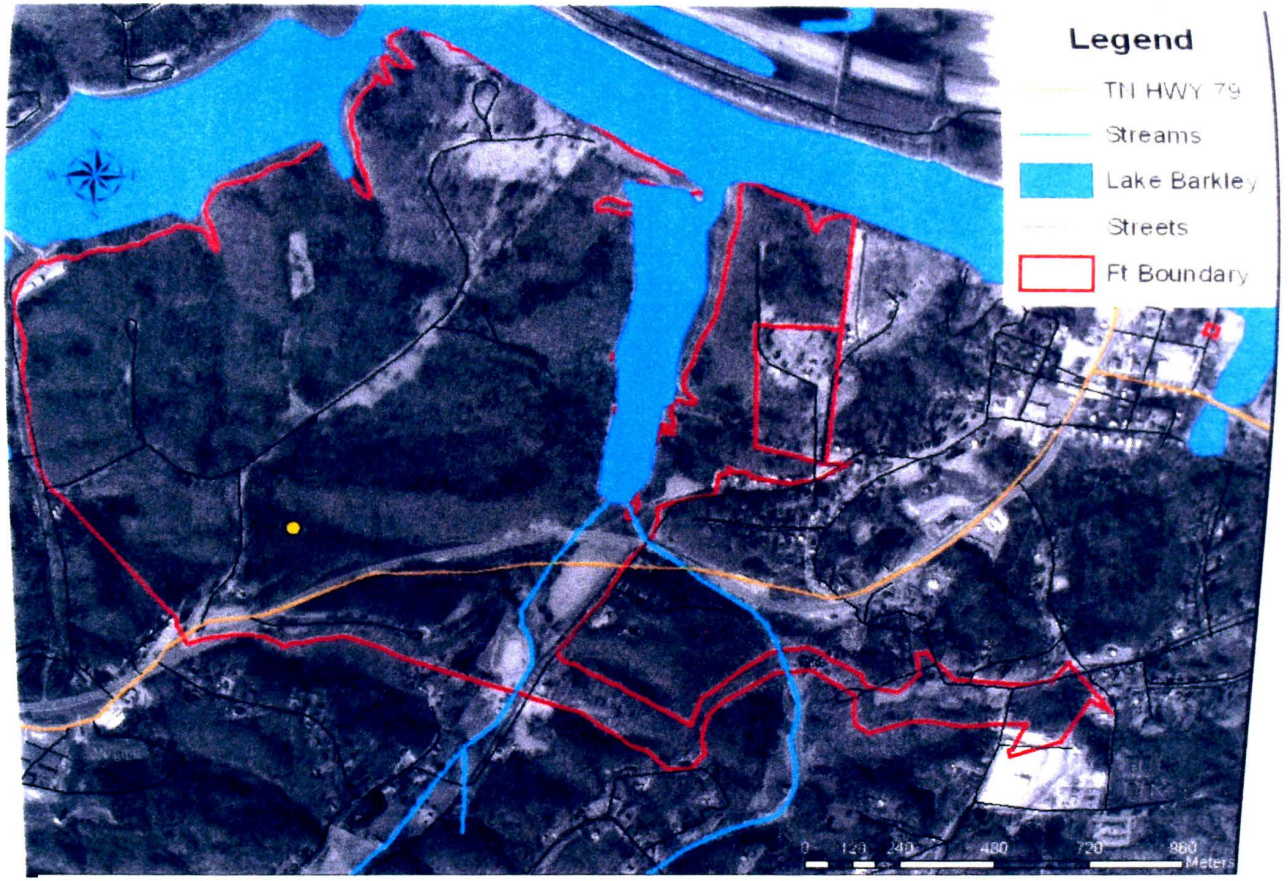


Figure A-25. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Psuedacris crucifer* was documented, January 2004 to June 2005.

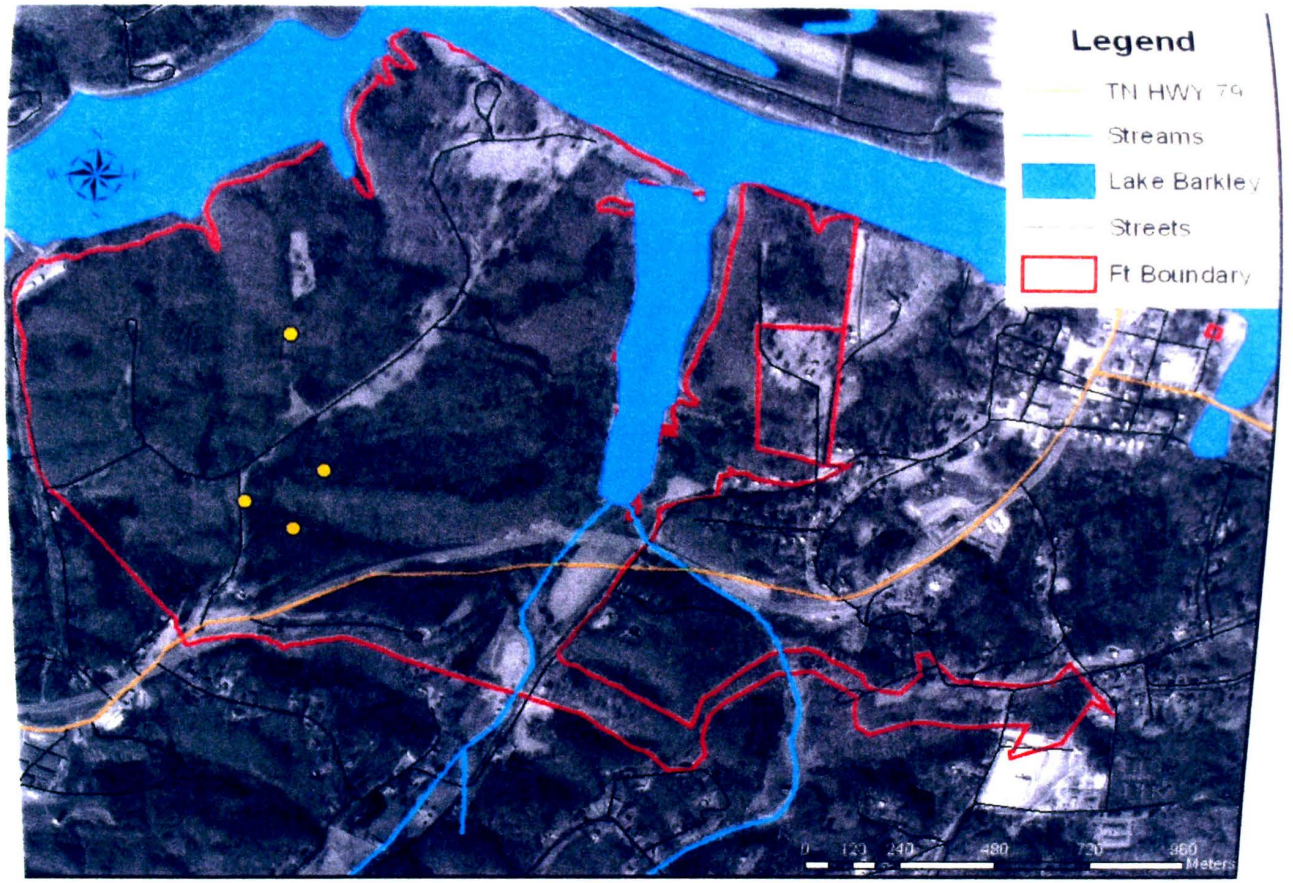


Figure A-26. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Psuedacris feriarum* was documented, January 2004 to June 2005.

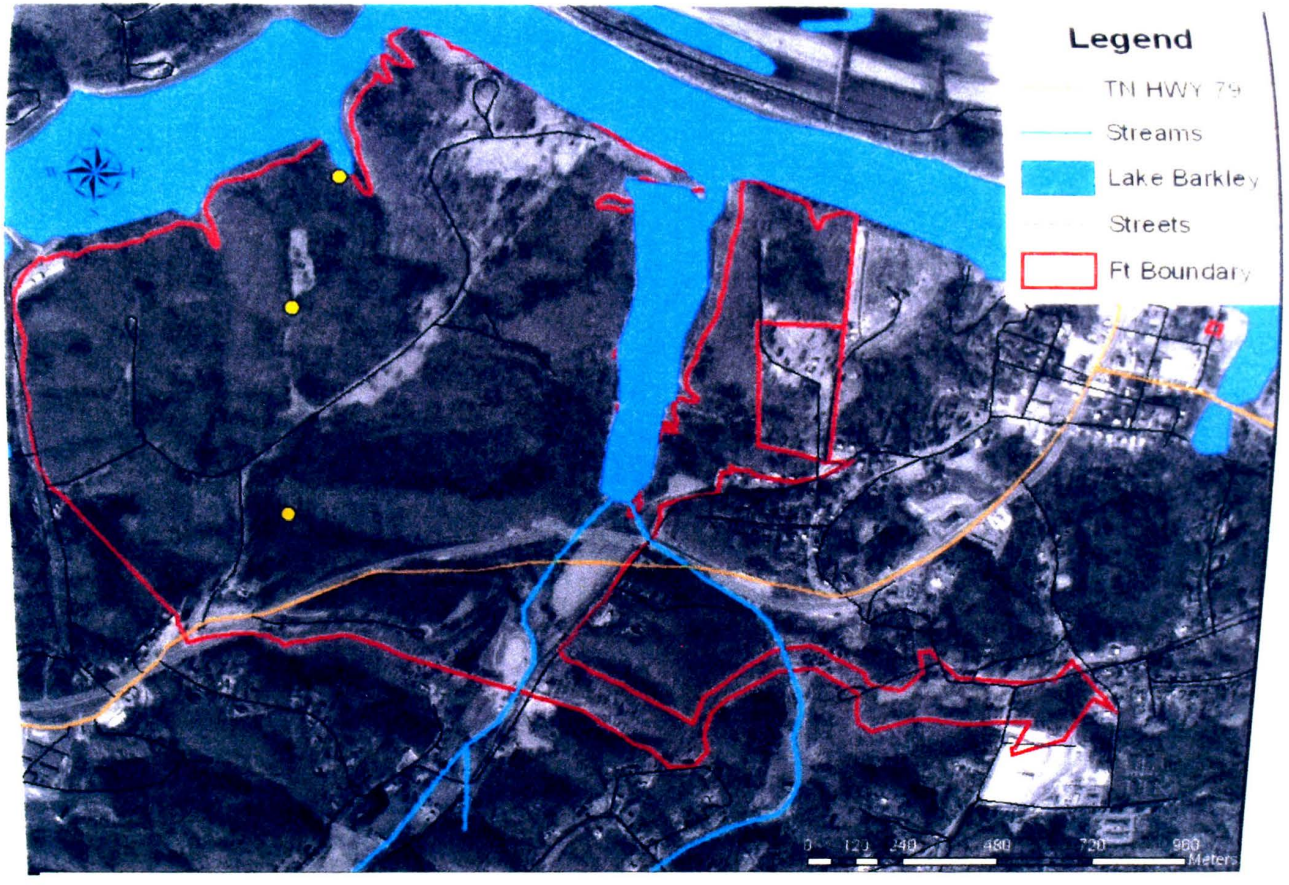


Figure A-27. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Rana catesbeina* was documented, January 2004 to June 2005.

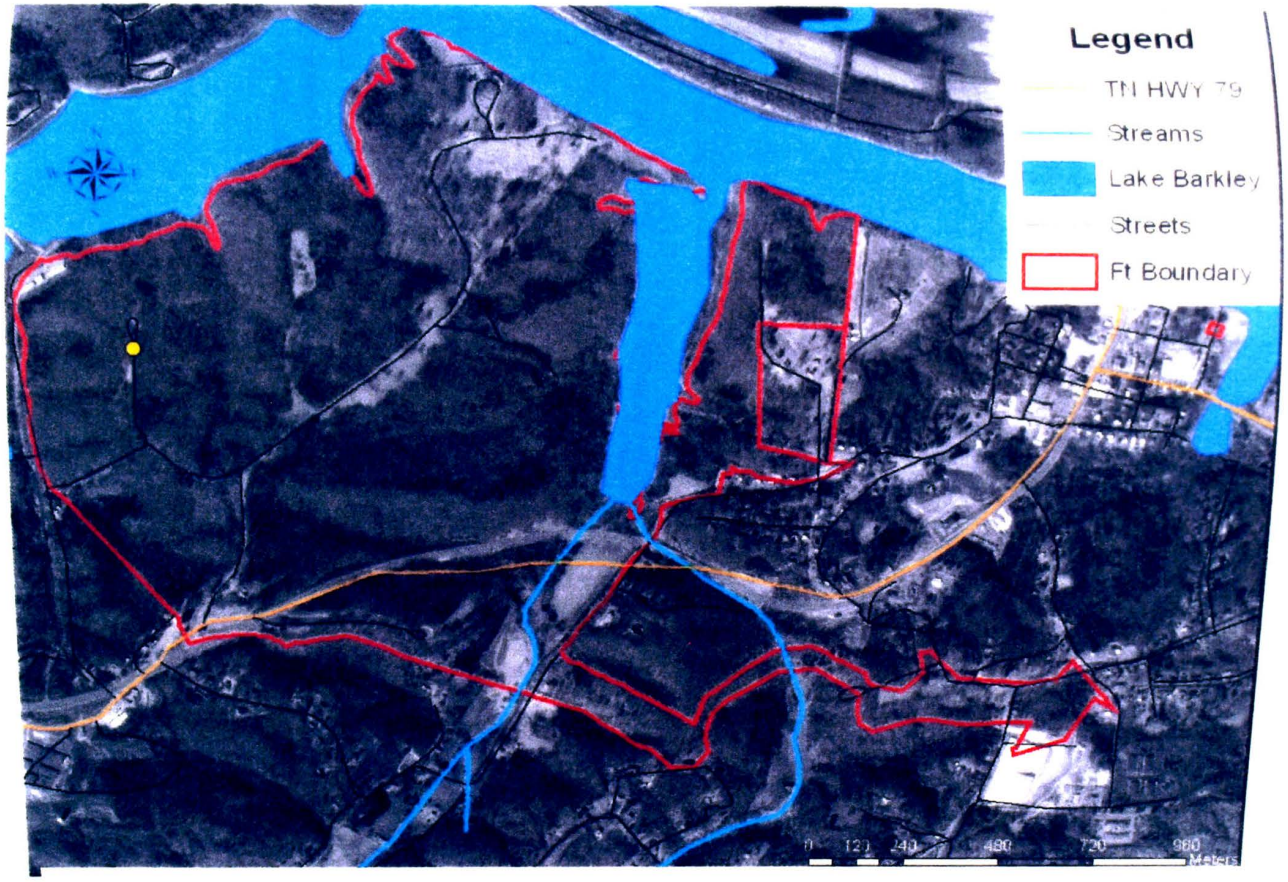


Figure A-28. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Rana clamitans* was documented, January 2004 to June 2005.

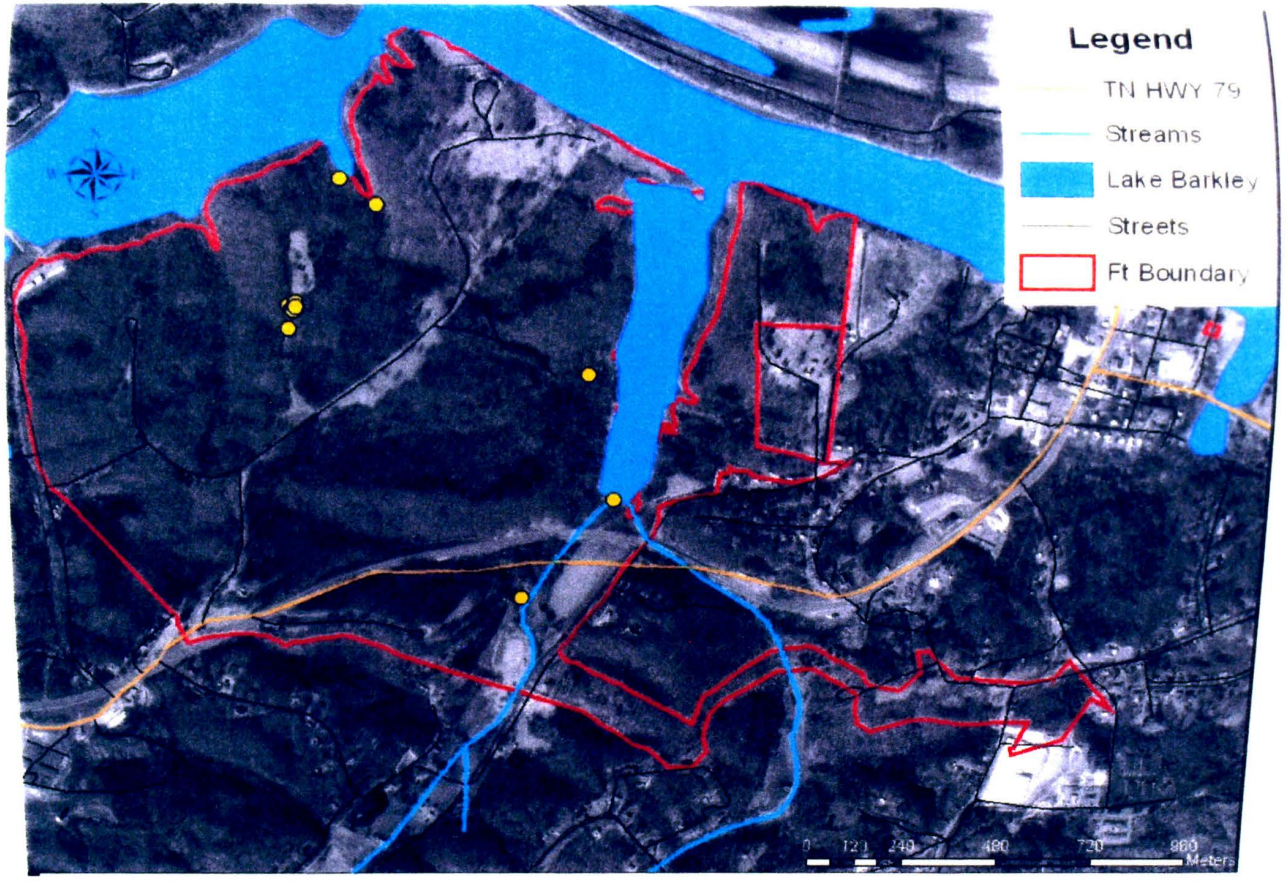


Figure A-29. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Rana sphenocephala* was documented, January 2004 to June 2005.

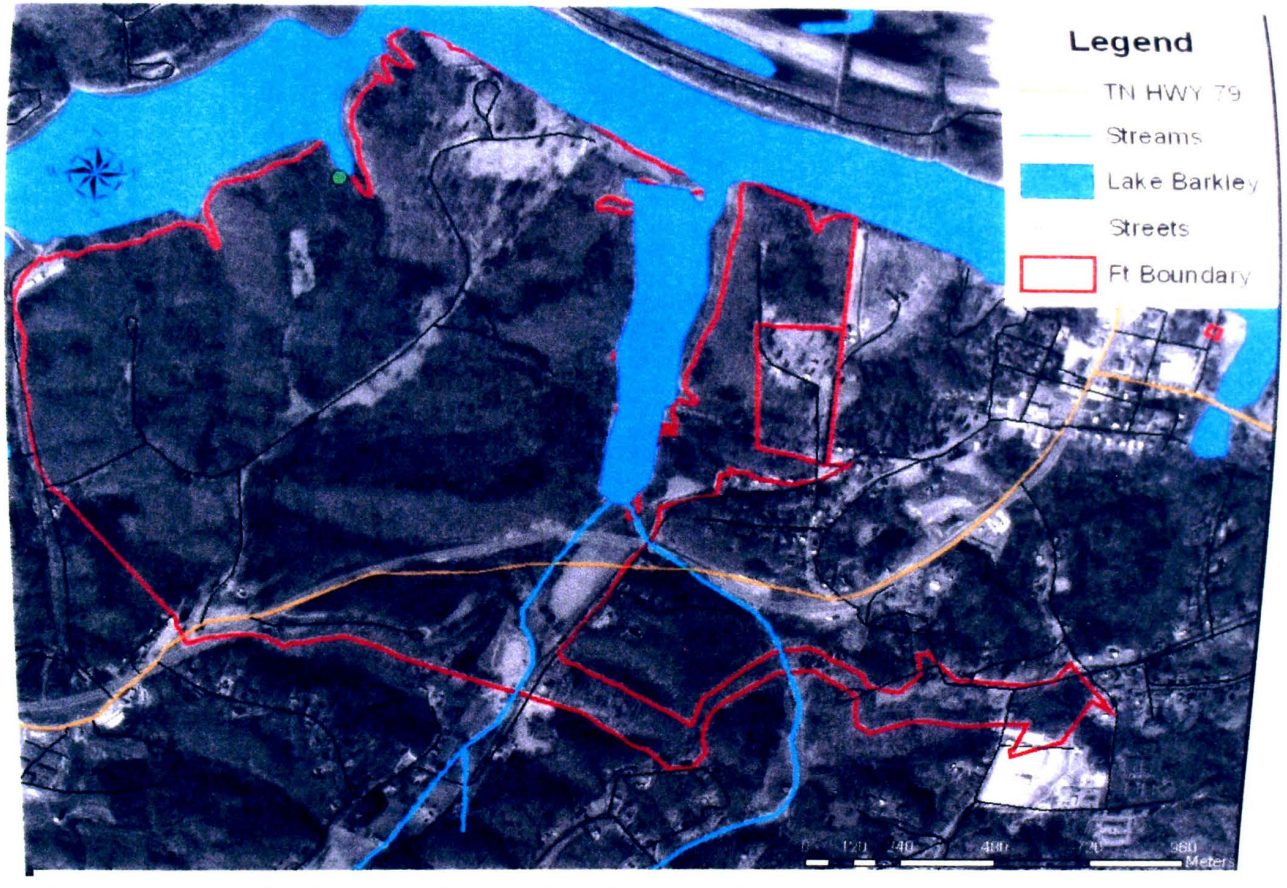


Figure A-30. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Regina septemvittata* was documented, January 2004 to June 2005.

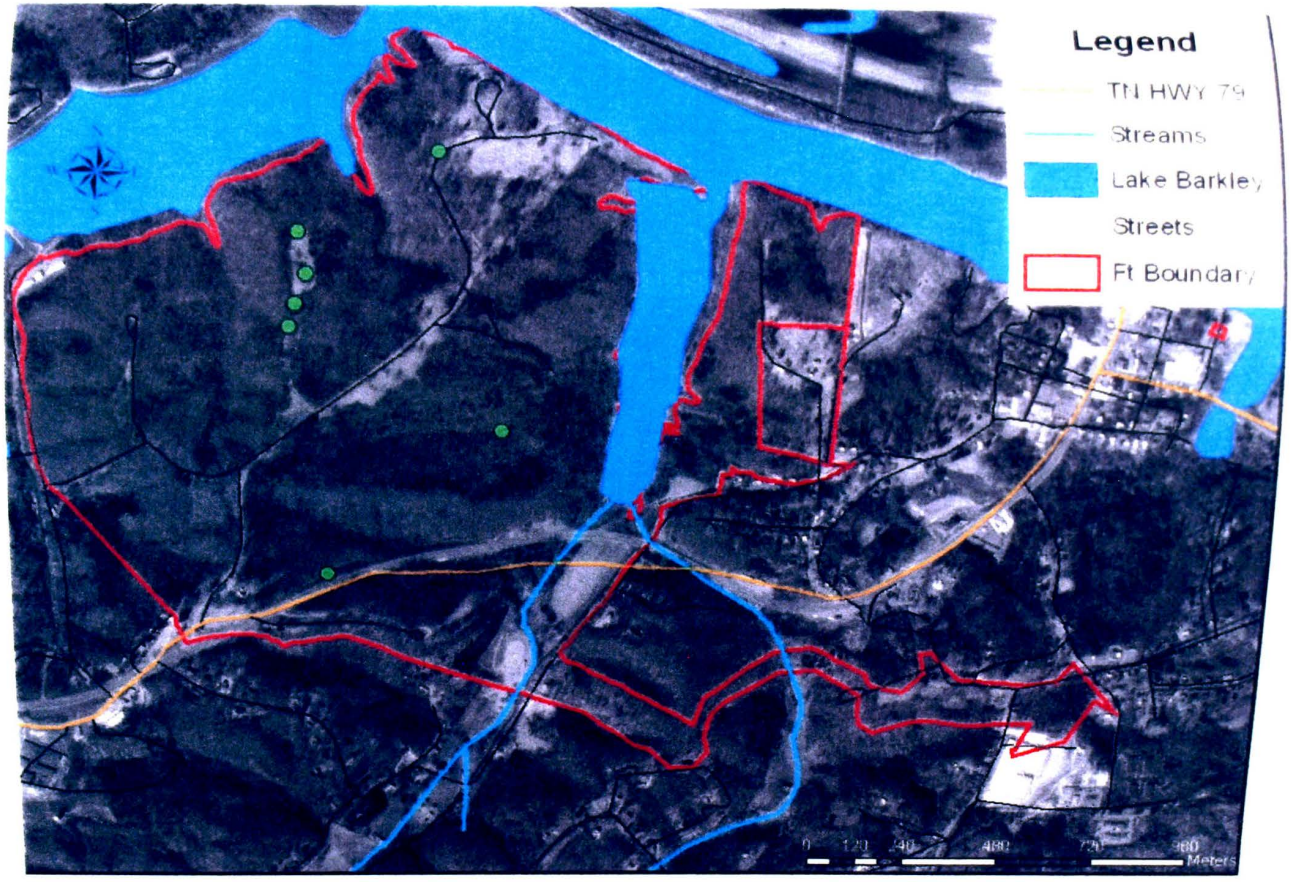


Figure A-31. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Sceloporus undulatus* was documented, January 2004 to June 2005.

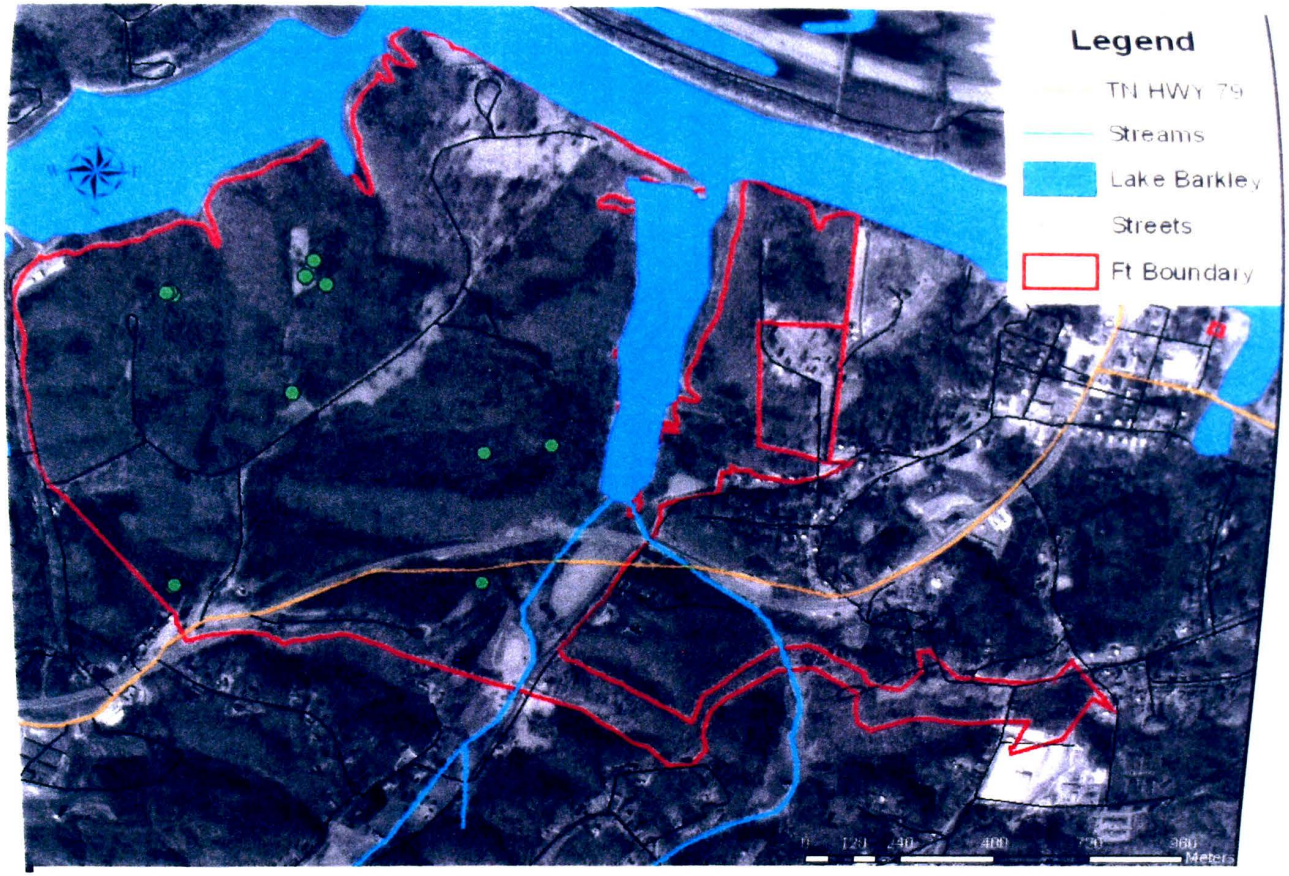


Figure A-32. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Scincella lateralis* was documented, January 2004 to June 2005.

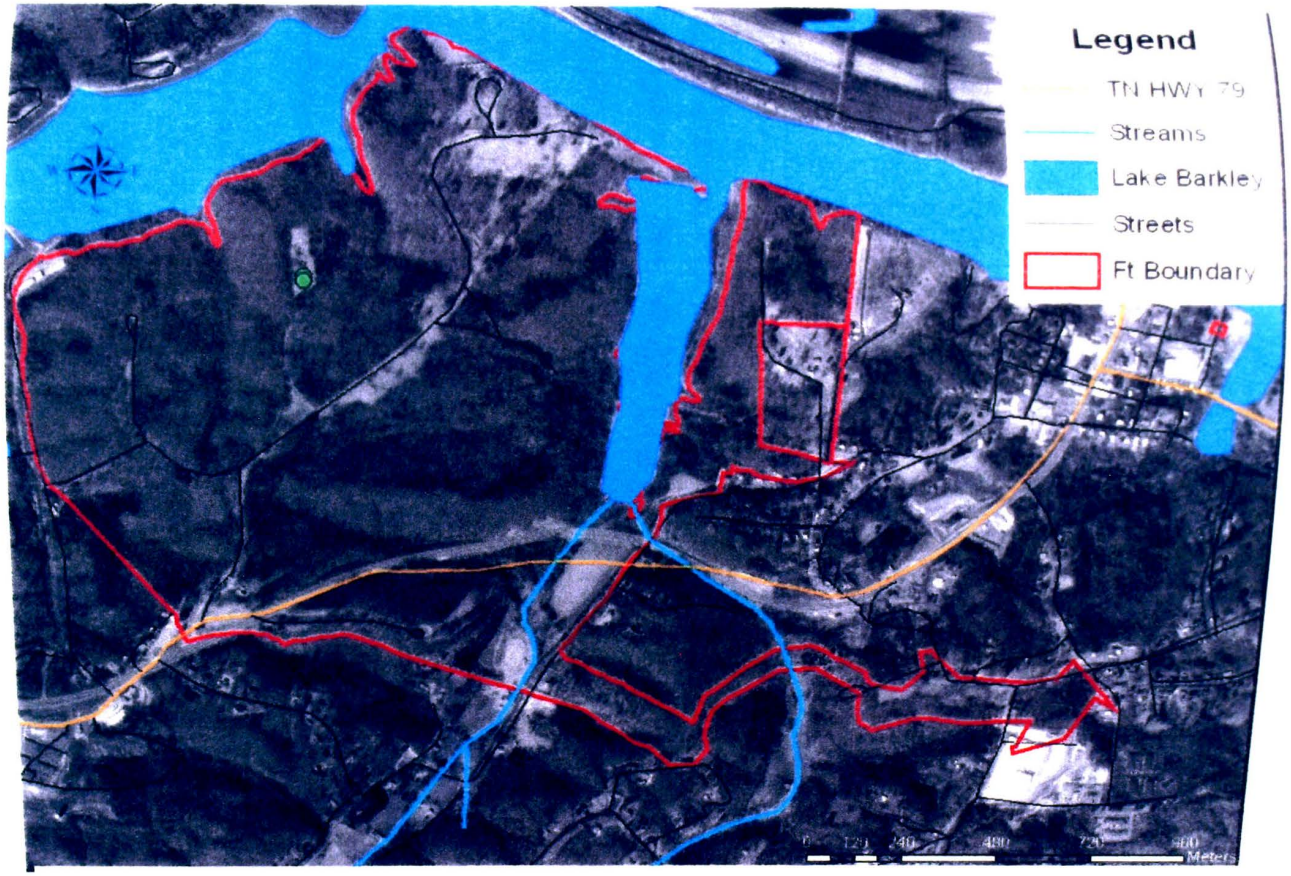


Figure A-33. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Storeria dekayi* was documented, January 2004 to June 2005.

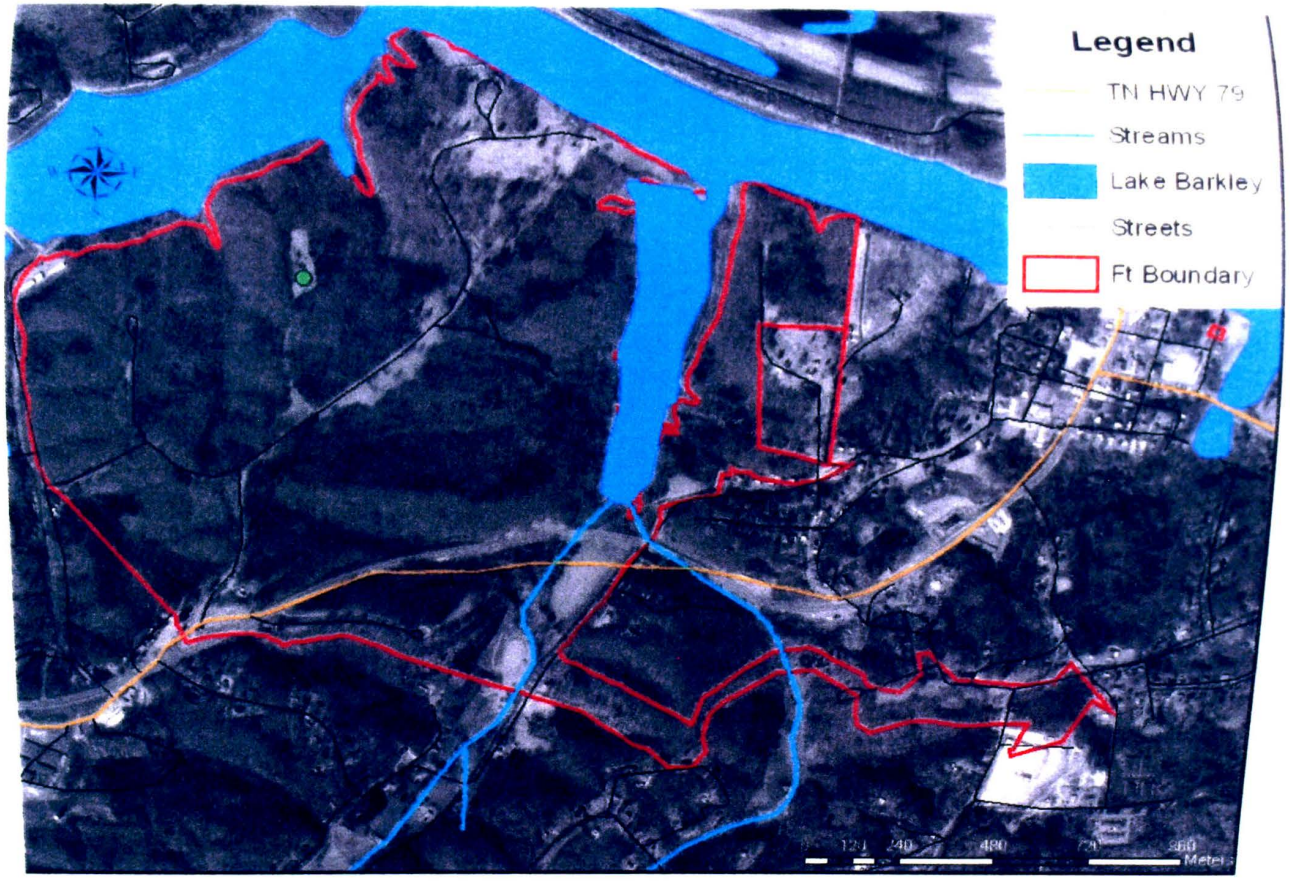


Figure A-34. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Storeria occipittomaculata* was documented, January 2004 to June 2005.

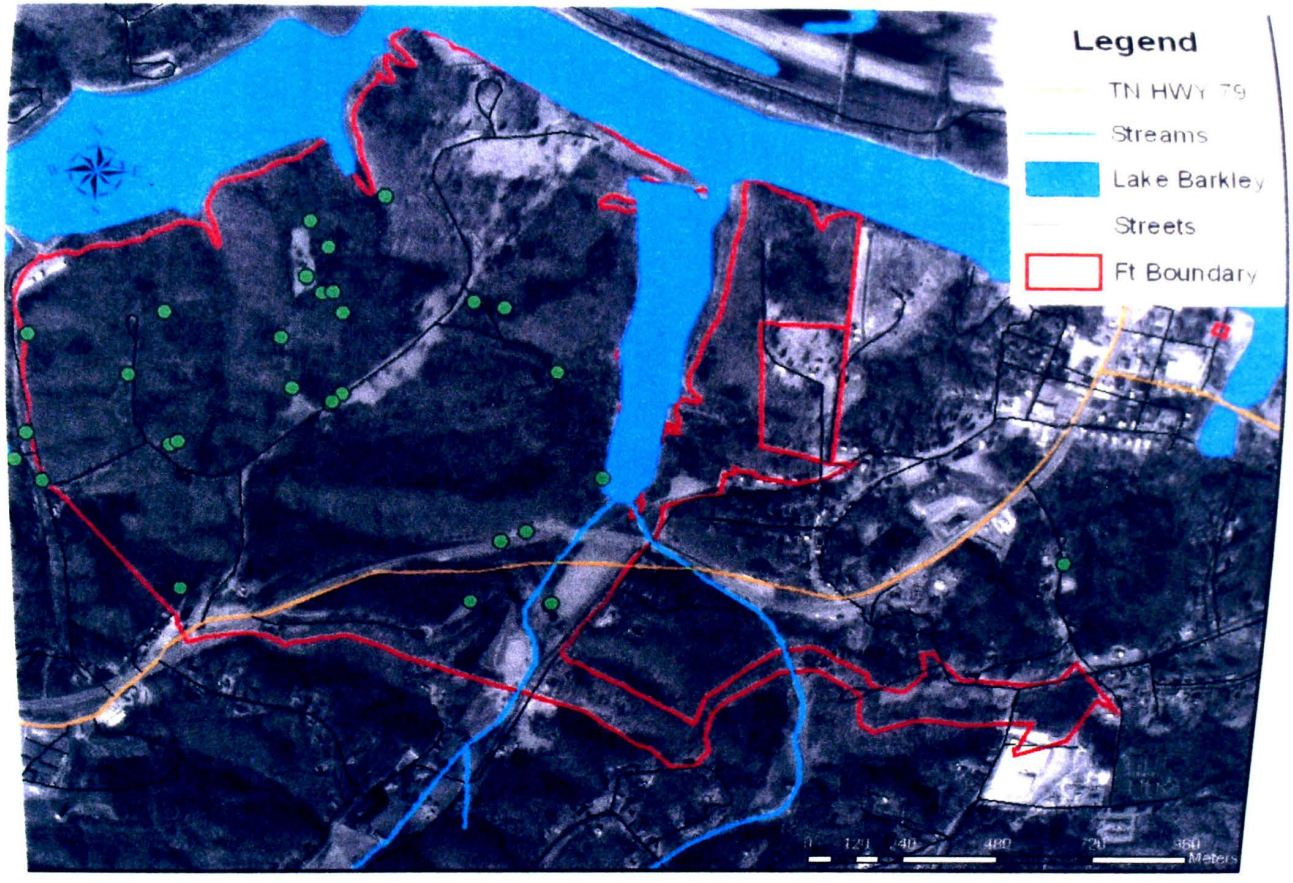


Figure A-35. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Terrepene carolina* was documented, January 2004 to June 2005.

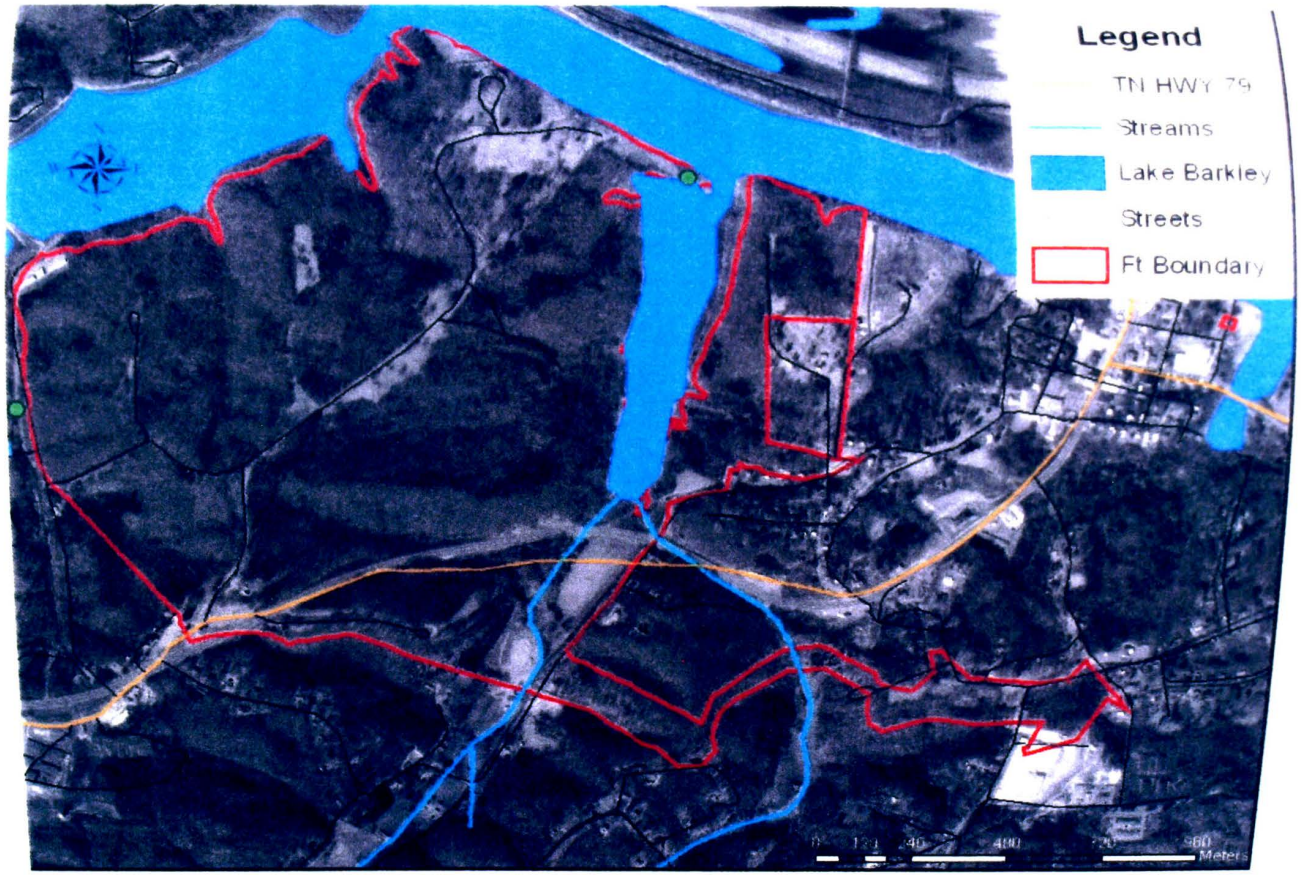


Figure A-36. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Thamnophis sirtalis* was documented, January 2004 to June 2005.

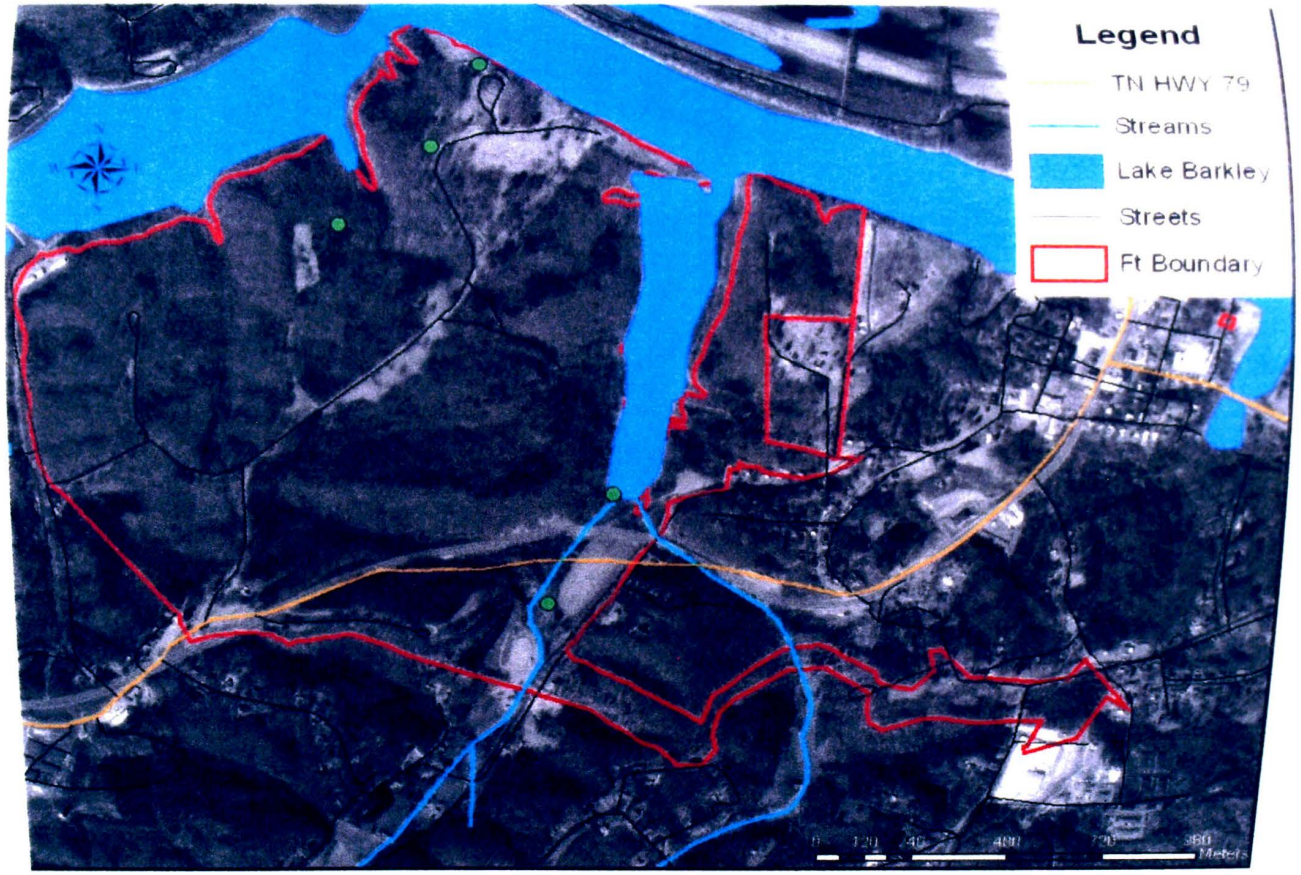


Figure A-37. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Trachemys scripta* was documented, January 2004 to June 2005.

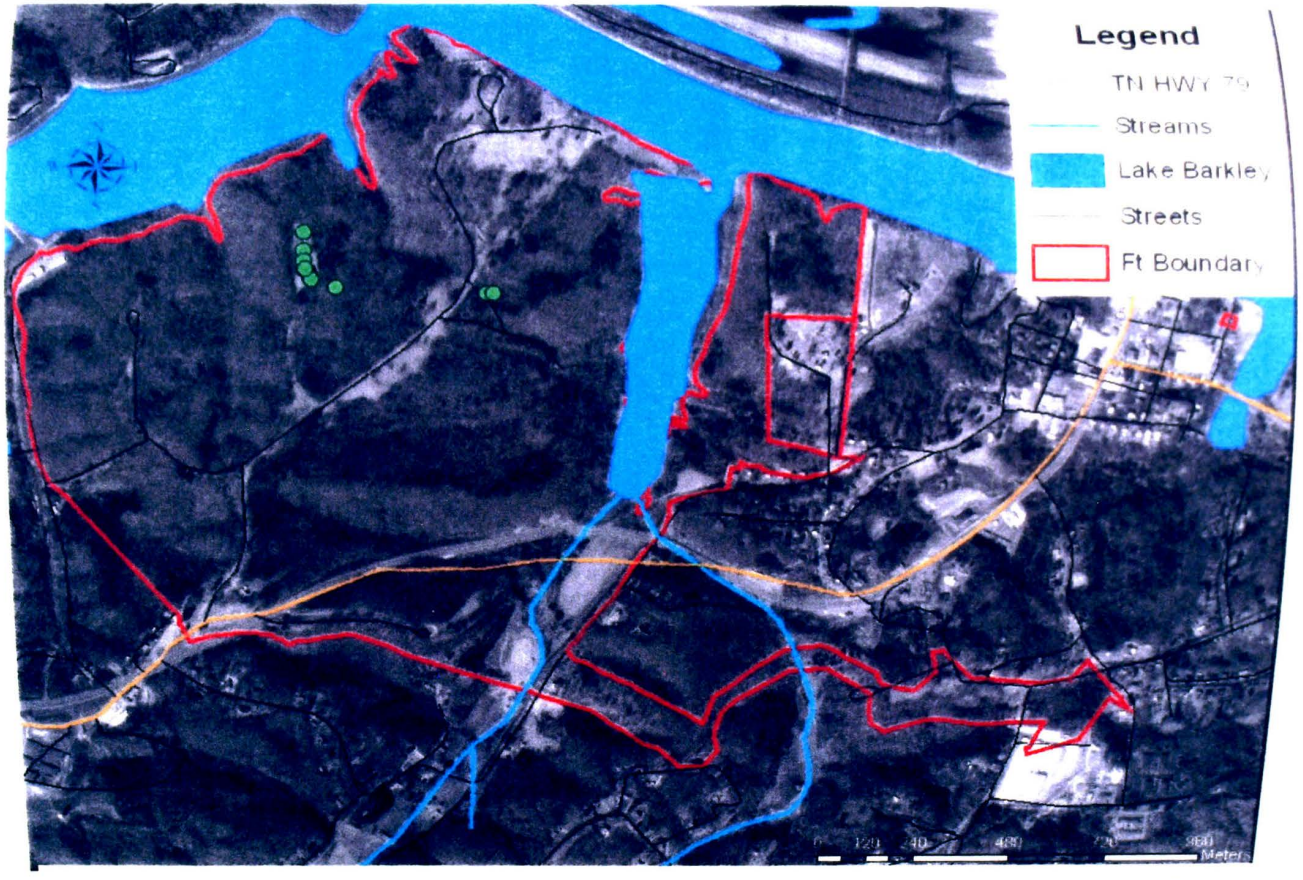


Figure A-38. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Virginia valeriae* was documented, January 2004 to June 2005.

## Vita

Jon Marshall Davenport was born in Sevierville, Tennessee on November 25, 1980. He attended public schools in Sevier County until graduation in May of 1999. In 1999, he enrolled at Maryville College in Maryville, Tennessee. He began his biological studies in the spring semester of his sophomore year. He graduated from Maryville College with a Bachelor of Arts in Biology in 2003. He then entered the graduate program at Austin Peay State University, Clarksville, Tennessee. He completed his Master of Science Degree in August of 2005.