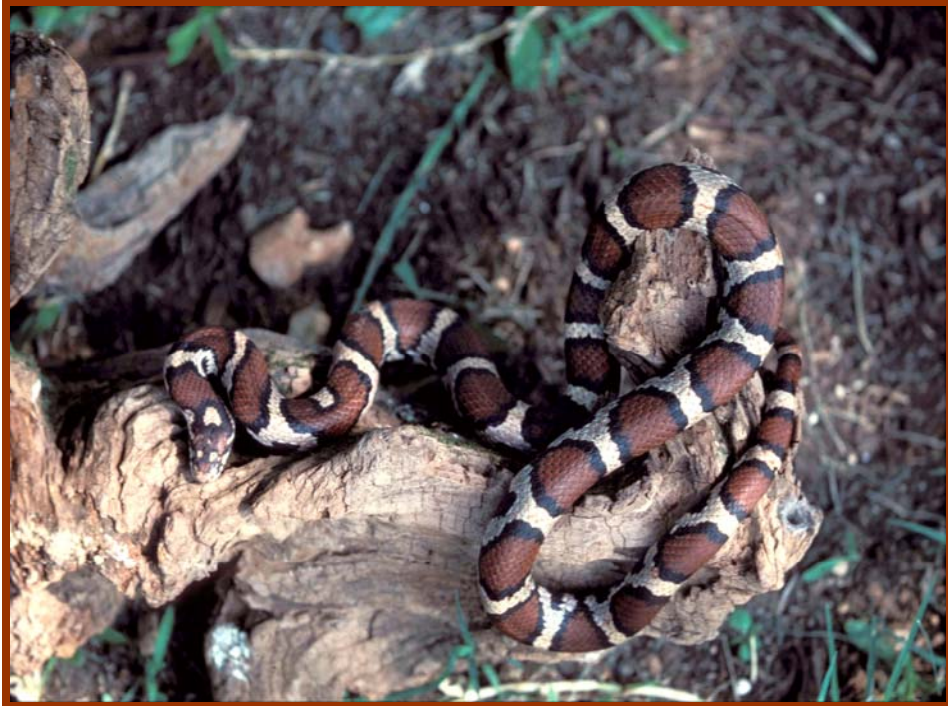


**INVENTORY OF THE AMPHIBIANS AND REPTILES
OF FORT DONELSON NATIONAL BATTLEFIELD,
STEWART COUNTY, TENNESSEE**



A. Floyd Scott and Jon Davenport

ON THE COVER

Two colorful representatives of the herpetofauna found in Fort Donelson National Battlefield: *Hyla cinerea*, Green Treefrog and *Lampropeltis triangulum*, Milksnake. Photos by Dwight Good (Green Treefrog) and Rick Harris (Milksnake).

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AMPHIBIANS AND REPTILES OF FORT DONELSON
NATIONAL BATTLEFIELD, STEWART COUNTY, TENNESSEE**

Final Report

Submitted to

The National Park Service

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TABLE OF CONTENTS

ABSTRACT	iv
LIST OF TABLES.....	v
LIST OF FIGURES	vi
LIST OF APPENDICES	vii
ACKNOWLEDGMENTS	viii
INTRODUCTION	1
Overall Goal.....	1
Specific Objectives.....	1
Description of Study Area	2
Location and Size.....	2
History.....	3
Physiography, Geology, Soils, Topography, and Hydrology	4
Vegetation	4
Weather and Climate	4
METHODS	5
List of Expected Species.....	5
Preliminary Activities.....	5
Sampling Efforts and Techniques.....	6
Plot Sampling.....	6
Drift Fence.....	6
Searches of Stream Reaches	7
Road Cruising.....	7

Tin Transect.	7
Haphazard Searching.	8
Sampling Schedule.	8
Data and Data Management.	9
Voucher Specimens.	10
RESULTS	10
Species Richness, Apparent Abundance and Habitat Use by Major Groups.	10
Yields of Various Sampling Techniques	12
Random Plot Yields in More Detail	13
DISCUSSION.	14
Species Detected Compared to Those Expected.	14
Comparison of Sampling Methods.	16
Results Compared to Those of Other Studies in Lower Cumberland Basin.	16
Possible Influence of Climate on Results.	17
CONCLUSIONS.	18
LITERATURE CITED.	19

ABSTRACT

We inventoried the amphibians and reptiles of Fort Donelson National Battlefield over a 20-month period beginning 1 January 2004 and ending 30 August 2005. Sampling was conducted using a variety of methods including random plot surveys, drift fences with pit and funnel traps, stream-reach searches, road cruising, a tin transect, and haphazard searches. The battlefield was visited at least twice monthly, but more often than not weekly trips took place, especially during periods of peak amphibian and reptile activity. Overall, 433 individuals representing 37 species were encountered within the battlefield's boundaries. Seventeen species (46%) were amphibians and 20 species (54%) were reptiles. Amphibians included seven species of salamanders and 10 species of frogs and toads. Species totals for reptiles were two turtles, four lizards, and 14 snakes. No state or federal listed species were among those documented. Plot sampling was the most effective method at detecting individuals and species, but was rivaled by road cruising, especially when it came to number of species detected. Results suggest that the herpetofauna of Fort Donelson National Battlefield is typical of what has been found in the region, especially considering its size and habitat diversity.

LIST OF TABLES

Table	Page
1. List of species of amphibians and reptiles expected to occur within the boundaries of Fort Donelson National Battlefield prior to the study, based on published and unpublished distribution data and reported habitat preferences.	26
2. Number of trips, total miles driven, and total man hours expended on trips to the study area (FODO) each month during the period of systematic sampling (1 January 2004 through 31 August 2005).	27
3. Numbers of times per month over the study period that each sampling technique was used while inventorying the amphibians and reptiles of Fort Donelson National Battlefield near Dover, Tennessee.	28
4. Species of amphibians and reptiles documented from January 2004 through August 2005 at Fort Donelson National Battlefield along with sampling methods detected by and numbers of individuals encountered overall and in each major habitat recognized on the area.	29
5. Totals for the numbers of specimens and species detected by each of the six sampling methods used during an inventory of amphibians and reptiles at Fort Donelson National Battlefield near Dover, Tennessee, January 1994 through August 1995.	30
6. Details of results of plot sampling for amphibians and reptiles at Fort Donelson National Battlefield from 1 January 2003 through 31 August 2005.	31
7. List of areas, other than Fort Donelson National Battlefield, in the lower Cumberland drainage basin that have been inventoried for amphibians and reptiles, along with author(s) of each study, date report was filed or published, size or area (ha) surveyed, and number of species documented.	32

LIST OF FIGURES

Figure	Page
1. Location of Fort Donelson (tree symbol) one mile west of Dover, in Stewart County, Tennessee.	33
2. Selected features within Fort Donelson National Battlefield in relation to surrounding roads, towns, and waterways.	34
3. Satellite image of Fort Donelson showing park boundary (red line), varied topography, and major cover types.	35
4. Comparison of the mean monthly temperatures at Fort Donelson National Battlefield during the period of this study (September 2003 through August 2005) with that for the 30-year period beginning January 1971 and ending December 2000.	36
5. Comparison of the means for average total monthly precipitation at Fort Donelson National Battlefield during the period of this study (September 2003 through August 2005) with that for the 30-year period beginning January 1971 and ending December 2000.	37
6. Topographical map of the Dover, Tennessee area showing the boundary of Fort Donelson National Battlefield (red line) and locations of 15 random plots (blue dots) and five special habitats (open triangles) identified for use in this study.	38
7. Diagram of the 1-ha random plot showing the location of the four 8x8 m constrained-search plots and the four cover boards (NPS, 2003).	39
8. Layout of discontinuous drift fence (with pit and funnel traps) used to sample amphibians and reptiles moving to and from the vernal pond located at 36.4896°N, 87.8608°W in Fort Donelson National Battlefield	40
9. Distribution of the records logged for species in the five major herpetofaunal groups documented at Fort Donelson National Battlefield from 1 January 2004 through 30 August 2005.	41
10. Relationship between the size of area sampled (after log transformation) and the number of species detected during inventories of the herpetofauna of eight different tracts in the lower Cumberland River Basin.	42

LIST OF APPENDICES

Appendix	Page
A. Names, identifying codes, UTM coordinates, and brief descriptions of prevailing plant communities at permanent sampling sites established during an inventory of the amphibians and reptiles of Fort Donelson National Battlefield, 1 January 2004 through 31 August 2005.	44
B. Maps Showing Locations Where Each Species Was Documented (Order of presentation is alphabetical by species' binomial)	45

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INTRODUCTION

Several studies (some published, others available only as theses or project reports) have been conducted that focused on the herpetofauna of Land Between The Lakes (LBL) and adjacent areas of the northwestern Highland Rim region of Middle Tennessee and south-central Kentucky. Information dealing directly with amphibians and reptiles in LBL was reviewed and discussed by Scott (2002). Reports from the surrounding area include those of Scott (1967), Scott and Snyder (1968), 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), Bufalino (1999), Rozelle (1999), Scott and Williamson (1999), Williamson (2001), Scott et al. (2000), and Bufalino and Scott (2002). Despite this wealth of information on the amphibians and reptiles of the region, prior to this study no data, published or unpublished, were available on the herpetofauna that inhabit Fort Donelson National Battlefield (FODO), which is located just south and east of LBL.

Overall Goal

The goal of this project was to fulfill the objectives of the Statement of Work (referred to hereafter as the SOW) prepared by the National Park Service (NPS) for an inventory of the herpetofauna of FODO, a NPS facility that is part of the Cumberland/Piedmont Network of parks inventory and monitoring network.

Specific Objectives

To achieve the above stated goal, the following specific objectives, as detailed in the SOW, were pursued:

- 1) Accurately describe the taxonomic richness, distributional aspects, and abundance of the herpetofauna throughout FODO at the level of species and, where applicable, subspecies;
- 2) Prepare a voucher collection of museum specimens and/or photos and recordings of those taxa not already vouchered in a curated collection, to be deposited at an NPS designated repository;
- 3) Collect data on selected environmental variables (weather conditions, vegetative community type, pH of soil and water, soil moisture, and structural features) at locations where specimens are obtained or photographed;
- 4) Conduct inventories over one and a half annual cycles with sampling occurring at least once per month throughout;
- 5) Document the results of the study with periodic hardcopy and electronic (MS Word) progress reports and a final report that is accompanied by hardcopy raw data on field forms and hard and digital (MS Access) inventory databases that include geospatial data on predetermined sampling plots, special habitats, and capture localities by species.

Description of Study Area

Location and Size

Fort Donelson National Battlefield is a 223-ha (552-acre) national park (National Park Service, 2003b), located adjacent to and just west of Dover in Stewart County, Tennessee (Fig. 1). The park is bordered by Barkley Lake (impounded Cumberland River) to the north and can be accessed via U.S. Highway 79, which bisects its southern section (Fig. 2).

History

Fort Donelson National Battlefield Park was created in 1930 by Public Law 187. Land acquisition followed for the next two years. Restoration of the fort's earthworks was also begun in 1931 along with historical interpretation planning. This all 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 limestones (United States Department of Agriculture, 1953). Narrow ridges, hills, ravines, steep slopes, and floodplains provide the park with diverse habitats and topography (Fig. 3). Also, one vernal pond, one ephemeral pool in a ravine wash, and two permanent streams are present providing potential living and breeding areas for amphibians. Of the two streams, Hickman Creek borders the northwest boundary of the park as a sizable embayment of Barkley Lake. The other stream, Indian Creek, also takes the form of an embayment along its lower reaches north of US Highway 79, but is a shallow, free-flowing stream with gravel substrate upstream to the park's southern boundary .

Elevations across FODO range from 110 m (360 ft) 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. Dominant among these are the cherty, droughty Bodine and Baxter soils (Springer and Elder, 1980).

Vegetation

Fort Donelson's vegetation, as defined by Braun (1950), falls within the Mississippi Plateau Section of the western Mesophytic Forest Region which is part of the Deciduous Forest Formation. The forest is dominated by several species of oaks (*Quercus* sp.) and hickories (*Carya* sp.), but also includes a significant amount of maples (*Acer* sp.) and elms (*Ulmus* sp.) (Chester, 1986). Most of the park is covered by deciduous forest in which occurs a scattering of open areas including mowed and successional fields, roads and roadsides, parking lots, and cemetery. At the time of this study, some fields were being restored with native warm-season grasses while others were being mowed for aesthetic value (Fig. 2). The forest within the park boundaries is considered secondary due to logging and agricultural disturbances that occurred prior to acquisition by the government (Chester and Wallace, 1997).

Weather and Climate

Stewart County has a warm-temperate, continental climate (USDA, 1953). Temperature and precipitation data for Dover, Tennessee spanning years 1971-2000 (as accessed from the Southeast Regional Climate Center's web site:

<http://www.dnr.state.sc.us/climate/sercc/index.html>) are as follows: The mean annual temperature is 14.0 °C, with July averaging the highest at 25.4 °C and January the lowest at 1.2 °C. The mean yearly total precipitation is 135.6 cm, with March averaging the wettest at 13.7 cm and October the driest at 8.9 cm. Compared to these averages are the means of temperature and precipitation that are based on daily readings taken by Park Service personnel at FODO during the two years (September 2003 through August 2005) of this study: mean temperature,

14.6 °C; hottest month, July at 25.7 °C ; coldest month, December at 3.8 °C; average total annual precipitation, 111.4 cm.; wettest month, April at 18.7 cm.; driest month, February at 3.4 cm. Comparison of the means for monthly temperature and total monthly precipitation at FODO for the period of this study and that of the 30-year period from 1971 through 2000 appear in Figures 4 and 5.

METHODS

List of Expected Species

A list of amphibian and reptilian species that were expected to occur at FODO (Table 1) was compiled based on published records and range maps (Conant and Collins 1998, Redmond and Scott 1996, and others cited in the introduction), unpublished records in the Austin Peay State University Museum of Zoology data base, and the variety of habitats found on the battlefield grounds. Included on the Expected List were 24 amphibians and 32 reptiles, of which 36 (17 amphibians and 19 reptiles) were considered highly likely to occur, 15 (six amphibians and nine reptiles) somewhat likely to occur, and six (five amphibians and one reptile) possible but not likely to occur.

Preliminary Activities

Prior to the commencement of sampling, a number of preliminary tasks had to be performed to legitimize the study. From September through November 2003, visits to the study area were made to secure a National Park Service collecting permit (No. FODO-2003-SCI-0001) and to become familiar with park offices, visitor center, cemetery, roads, habitat diversity and distribution, and general lay of the land. During December 2003, additional trips were conducted to install sampling devices in random plots and special habitats.

Sampling Efforts and Techniques

Systematic sampling commenced in January 2004 and continued through the end of August 2005. During this period, 119 trips involving 9223 road miles and 695 man hours were taken to the study area. Table 2 includes a breakdown of these data on a monthly basis during the sampling period. Sampling was conducted using several methods aimed at detecting the variety of herpetofauna expected on the area.

Plot Sampling

Fifteen randomly selected 1-hectare plots served as the basis for sampling the park's herpetofauna (see Appendix A for plot coordinates and attributes). 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 forested habitats across the park, whereas three were in partially open, successional or maintained fields (Fig. 6). Each 1-hectare plot was divided into four sections by two intersecting transects that terminated on the plot's circumference (Fig. 7). 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 consisted of roofing tin measuring 0.69 by 1.2 m; along the other transect cover objects were made of 0.64-cm thick sheets of untreated plywood measuring 1.2 by 1.2 m on a side. Also, along each transect beginning at 12 m from the center of each plot and extending outward to 20 m, subplots measuring 8 by 8 m were established (Fig. 7) and used for area-constrained searches (National Park Service, 2003a).

Drift Fence

At the one ephemeral pond (SH1) on the area (Fig. 6 and Appendix A), a discontinuous

drift fence accompanied by pit and funnel traps was erected. Supported by wooden stakes, the fence consisted of three, 10-m sections of 50-cm wide aluminum valley material separated by gaps of approximately 5-m each (Fig. 8). To capture animals moving along each side of the three sections of drift fence, we installed a pair of pit traps (5-L plastic bucket) and two pairs of wire funnel traps near their center points and a single terminal pit trap at their ends. The basic drift-fence design followed that described by Dodd and Scott (1994).

Searches of Stream Reaches

A section of Indian Creek upstream from US Highway 79 (SH2) and a small tributary to Hickman Creek (SH3) were sampled once monthly using the time-constrained search technique (Heyer et al. 1994). Starting at the same point each time, one individual would work upstream for a distance of 100 m searching for amphibians and reptiles under rocks and other cover objects, which were returned to their original positions after overturning. See Figure 6 and Appendix A for more information on these stream reaches.

Road Cruising

Road cruising (Shaffer and Juterbock, 1994) along the park's 3.7 km of roads was conducted both day and night during each of the four seasons in search of living or road-killed specimens. Efforts of this nature during the day involved driving around the park from random plot to random plot or special habitat when on weekly visits; at night it usually occurred during or soon after periods of rain and involved a regular route covering the length of most paved roads on the area.

Tin Transect

To increase the amount of sampling effort occurring in open areas of the battlefield (which were not well represented in the random plots), a 150-meter transect was established

across the long axis of a field (SH4) dominated by grasses and herbs but containing a scattering of small hardwood and cedar trees (Fig. 6, Appendix A). At 10-m intervals along the transect, pieces of galvanized roofing tin measuring 0.69 by 1.2 m were placed firmly on top of the existing vegetation to provide potential cover for amphibians and reptiles moving in the area. The tin along the transect was checked regularly for the presence of animals taking shelter beneath it.

Haphazard Searching

Throughout the sampling period, haphazard or opportunistic encounters with individual amphibians or reptiles were used to augment the data being accumulated by the other methods. Most records obtained by this method resulted from fortuitous sighting and hand captures made while walking trails or traversing woods and fields in route to the random plots. Haphazard searches were also conducted occasionally at an ephemeral pool (SH5) located along a steep-gradient, intermittent stream behind the Visitor Center (Fig. 6 and Appendix A).

Sampling Schedule

The battlefield was visited at least twice monthly with many visits occurring weekly especially during periods of peak amphibian and reptile activity. On each visit the pieces of artificial cover in each plot and along the tin transect were lifted to check for animals taking refuge there. Rocks and other forest debris were also overturned by hand in the sub-plots when conducting area-constrained searches. At least once monthly, each 100-meter stretch 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 number of times per month each sampling technique was used during the study is given in Table 3.

Data and Data Management

Data that were routinely recorded on each trip to the study area included: date, person or persons participating, vehicle being used, odometer readings at start and end, distance driven, time start, time end, total man hours expended, current weather, and weather over the past 24 hours.

Information recorded upon encountering specimens included species abbreviation (first letter of genus followed by first three letters of species epithet), date, plot or site code, Universal Transverse Mercator (UTM) coordinates, time of day, mass (g), air, water and soil temperatures, when applicable (C°), sex (if discernable externally), level of maturity (larva, juvenile, adult), reproductive condition (if evident), body measurements (snout-vent length [SVL] in mm if a salamander, lizard or snake; snout-urostyle [SUL] in mm if a frog, straight-line carapace length [CL] in mm if a turtle), notes on habitat, collector's field number, and incidental remarks. Species identifications were determined with the aid of the field guide by Conant and Collins (1998), Snyder's (1972) book on the amphibians and reptiles of LBL, and the investigators' personal knowledge of the fauna. Species names (scientific and vernacular) used are those proposed by Crother (2000), except for *Pantherophis spiloides* which replaces *Elaphe obsoleta* following the taxonomic work of Burbrink (200_) and Utiger et al. (2002). UTM coordinates were read with a Garmin GPSIII Plus receiver. Specimens were weighed with Pesola spring scales or on an Ohaus CS-2000 balance unit. Temperature was measured with either an Enviro-Safe® pocket thermometer or Reotemp, Model A, soil thermometer. Linear measurements were taken with plastic metric rulers and, in the case of larger snakes, a string or clear plastic tube.

In the field, data were routinely recorded in a field notebook and/or on field data sheets. Then, back in the lab, it was digitized using Microsoft Access (2002) software. After being

transcribed from paper to digital format, the data were checked to eliminate any transcription errors. Data files were stored on a Dell Optiplex GX270 computer and routinely backed up on Iomega 100MB zip disks.

Voucher Specimens

Since no listed species (those on the official Tennessee and/or United States government list of endangered or threatened fauna) were encountered, one to five or fewer specimens (several of which were road-killed individuals) of each taxon were collected and processed as voucher specimens. After being assigned NPS (1664-1733) and APSU (18056-18125) catalog numbers, all vouchers were deposited in Austin Peay State University's Museum of Zoology.

RESULTS

Species Richness, Apparent Abundance, and Habitat Use by Major Groups

During the 20-month sampling period, 37 species represented by 433 individuals were encountered within the battlefield's boundaries. Seventeen species (46%) were amphibians and 20 species (54%) were reptiles. Among the amphibians were seven species of salamanders represented by 141 total records and 10 species of frogs and toads with 139 total records. Species numbers for the major groups of reptiles included two turtles (46 total records), four lizards (30 total records), and 14 snakes (77 total records). Table 4 includes a list, by major groups, of the species that were encountered along with the numbers of times each was documented in the battlefield's four major habitats, and the sampling method or methods by which each was detected. The following paragraphs address each of the major groups of amphibians and reptiles documented on FODO and are based on the data in Table 4.

Two species, both in the genus *Plethodon*, dominated among the group of seven salamanders encountered. In order of apparent abundance, these included *P. dorsalis* and *P.*

glutinosus, representing 53% and 28%, respectively, of all salamander observations. All records for both of these species came from forested areas of the battlefield. Accounting for 65% (15 of 23) of the records, *Desmognathus conanti* was the most abundant of the three species of salamanders found in or along streams.

Among frogs and toads, two species of *Bufo* were encountered most frequently: *B. fowleri* records made up 39% of all anuran encounters, while *B. americanus* accounted for another 21%. Except for *Rana sphenoccephala* at 15%, the remaining eight species in this amphibian group were each represented by less than 10% of the group's total captures. Unlike salamanders, frogs and toads were spread more evenly among habitat types, especially in association with the ephemeral pond.

Only two species of turtles were documented on the area. Not unexpectedly, the dominant of these was *Terrapene carolina*, a common inhabitant of oak-hickory and other forest associations in eastern North America (Dodd 2001). Eighty-nine percent of the turtle records were for this species. The remaining turtle encounters (five of 46) were with *Trachemys scripta* at or near streams bordering or penetrating the battlefield grounds.

Lizard species encountered numbered four with *Scincella lateralis* representing 50% (15 of 30) of all lizard records. Thirteen of these encounters were in the forest habitat and two were in a field situation. Following in order of apparent abundance were *Sceloporus undulatus* (30%), *Eumeces fasciatus* (13%), and *Eumeces laticeps* (7%).

Encounters with snakes totaled 77, but were distributed among 14 species. Only four of these were represented by 10% or greater of all snake encounters. In descending order according to percent of snake records logged, these were *Diadophis punctatus* at 29%, *Coluber constrictor* at 18%, *Lampropeltis getula* at 17%, and *Virginia valeriae* at 16%. All but four encounters with

snakes occurred in either the forest or field environment. The four snake records logged outside these habitats were for natricine and related species in or along streams.

Figure 9 depicts, with variously colored dots, where individuals of each of the major herpetofaunal groups (frogs and toads, salamanders, lizards, snakes, and turtles) were found during the study, while distribution maps for the individual species (arranged alphabetically) are presented in Appendix B.

Yields of Various Sampling Techniques

The primary and most wide-spread approach to sampling involved the 15 randomly distributed plots with cover objects and sub-plots in which area-constrained searches were conducted. However, five additional collecting techniques were also used to sample special habitats and other areas not represented in the random plots (i.e. streams, ponds, field with scattered young trees, roads, and trails). These, along with the total number of specimens, total number of species, and number of species found only by each method appear in Table 5.

Plot sampling was most effective, yielding the highest number of individual records (134) and the greatest number of species (20). However, no species were found by this method alone. Following plot sampling (based on the total number of records logged) in effectiveness was drift-fence sampling, which yielded 107 records but only nine total species. And, as with plot sampling, no species were found only by this method. Next most productive was road cruising producing 53 individual records, 17 species detected, and six species (*Agkistrodon contortrix*, *Hyla cinerea*, *Hyla chrysoscelis/versicolor*, *Lampropeltis triangulum*, *Notophthalmus viridescens*, *Pantherophis spiloides*, and *Opheodrys aestivus*) that were found only by this technique. Following road cruising were two techniques that yielded similar results, especially in terms of total records and numbers of species not found by any other method. These were

haphazard searches and a transect with half sheets of roofing tin spaced 10 m apart across a grassy field containing a few scattered young trees. Respectively, these two methods produced 41 and 45 records, 15 and 11 total species, and each was responsible for detecting two species (*Pseudacris crucifer* and *P. feriarum* via the former; *Storeria dekayi* and *S. occipitomaculata* via the latter) that were not detected by any of the other methods. Least effective overall were the timed-constrained searches conducted along the two streams flowing through the battlefield into Barkley Lake. Combined, these efforts resulted in a total of 30 records and nine species, two of which were found only by this method.

Random Plot Yields in More Detail

Since plot sampling was the most widespread and randomly distributed of the techniques used and because it yielded the greatest number of individuals and species, details of the results obtained via this method are presented in Table 6. The 20 species encountered via plot sampling made up 54% of the 37 species documented on the area. Of the amphibian species, four were frogs or toads and four were salamanders; reptile species included two turtles, four lizards, and six snakes. Most frequently encountered (eight of 15 plots) and found in the greatest numbers (33 total) was *Plethodon glutinosus*, which was followed closely by *Diadophis punctatus*, *P. dorsalis*, *Scincella lateralis*, and *Terrapene carolina*. For species below the top five, both numbers of individuals found and frequency of occurrence drop off considerably with the bottom nine being represented by only one or two individuals found in only one plot.

As for which plots were most productive, plot 6 topped the list with eight species represented by 28 individuals. It was followed closely by plot 1, with seven species and 15 individuals, and plot 9, with six species and 23 individuals. Others ranged from five species and 15 individuals down to two species and two individuals.

DISCUSSION

Species Detected Compared to Those Expected

Sixty-six percent (37 of 56) of the species of amphibians and reptiles on our FODO expected list were documented in this study. This included 71% (17 of 24) of the amphibians and 63% (20 of 32) of the reptiles on the list. Broken down by levels of likelihood of occurrence, 86% (31 of 36) of those considered “highly likely to occur” were encountered, 27% (4 of 14) of those considered “somewhat likely to occur” turned up, and 25% (1 of 5) of those considered “possible but to the least degree” were found. No species among those found within the battlefield’s boundaries was on any state or federal list of taxa considered endangered, threatened, or otherwise of conservation concern (Tennessee Department of Conservation 2004).

Only seven of the 12 salamanders (58%) listed as expected on the area were documented. Three of these (*Ambystoma opacum*, *A. texanum*, and *A. tigrinum*) probably owe their absence to the paucity of favorable breeding sites (fishless ponds that contain water at least from mid-winter through early summer) at FODO. The only member of the genus *Ambystoma* to be documented was *A. maculatum* and it by only two adults. Two streamside salamanders that were expected but not detected included *Eurycea longicauda* and *Pseudotriton ruber*. Although possibly overlooked, they are described by Petranka (1998) as inhabitants of seepage areas and springs, two aquatic features not associated with the streams in FODO.

Eighty-three percent (10 of 12) of the frog and toad species we expected to occur within the boundary of the battlefield were found. The two missing species were *Gastrophryne carolinensis* and *Scaphiopus holbrookii*, both of which are recognized as secretive, burrowing anurans that favor habitats with sandy, gravelly or other loose soils (Behler and King 1998).

Two species of turtles were expected and both were documented during the study. One

was *Terrapene carolina*, a common inhabitant of open woodlands in eastern United States (Ernst and Barbour 1972), and the other was *Trachemys scripta*, an aquatic turtle that prefers quiet waters with soft bottoms (Gibbons 1990) like those of Hickman and Indian creeks embayments which border the battlefield grounds.

Of the six lizard species expected at FODO, four were considered highly likely to occur, one somewhat likely to occur and one expected, but to the least degree. All four species (*Sceloporus undulatus*, *Eumeces fasciatus*, *E. laticeps*, and *Scincella lateralis*) in the first category were encountered on the area, whereas neither of the other two (*Cnemidophorus sexlineatus* and *Eumeces inexpectatus*) was found. One of the undocumented lizards (*C. sexlineatus*) was reported by Snyder (1972) to be locally abundant in nearby LBL occurring “in scattered colonies in areas of dry, loose soils with lots of sun,” a situation not commonly found at FODO. The other species (*E. inexpectatus*) was not listed from LBL by Snyder (1972), but was subsequently discovered (by Snyder himself) among the LBL voucher specimens in the reptile collection at Austin Peay State University. Still, it is considered rare in LBL (Scott et al. 1999) and the surrounding region.

Twenty-one species of non-venomous snakes (Family Colubridae) were expected at FODO (Table 1), but only 13 (62%) were documented (Table 4). Eleven of those found were considered highly likely to occur, while one each fell into the other two categories of expected occurrence. Of the eight species not encountered, one (*Pituophis melanoleucus*) was considered highly likely to occur (mainly because a specimen that was found dead on US Highway 79 less than a mile west of the battlefield boundary is in the reptile collection at Austin Peay State University), six (compare lists in Tables 1 and 4) were considered somewhat likely to occur, and one (*Thamnophis sauritus*) was expected, but to the least degree. Lack of habitat and scarcity in

the region are likely reasons why we failed to document so many expected species of colubrid snakes.

One species of venomous snake (Family Viperidae) out of three listed as possible for the area (Table 1) was found during the study. This was *Agkistrodon contortrix*, the species considered by Snyder (1972) to be the most common of the venomous snakes in LBL. Not found were *Crotalus horridus* and *Sistrurus miliarius*, neither of which was considered highly likely to be present.

Comparison of Sampling Methods

When comparing the yields (both in terms of individuals and species) of the various sampling techniques used (Table 5), it becomes clear that no single method would have resulted in an accurate estimate of the relative abundance and species richness of FODO's herpetofauna. Although random-plots and the drift fence accounted for the highest number of individuals caught (294 combined), it amounted to only 59% of the total. The remaining 41% of individual captures were fairly evenly divided among the other four methods: road cruising (13%), tin transect (11%), haphazard searching (10%) and stream searches (7%). As for the number of species detected, random plots and the drift fence combined yielded 25 of the 37 species (68%), but neither was the only method accounting for any one species or group of species. In contrast, road cruising was the only method used that detected six of the species, and two species each were found only by the other three techniques. Thus, 37% of the herpetofauna documented would have been missed had we not augmented random plot and drift-fence sampling with other techniques.

Results Compared to Those of Other Studies in Lower Cumberland Basin

Inventories conducted of the herpetofauna of six other areas (Table 7) in the lower

Cumberland drainage basin yielded species totals ranging from 34 to 66. When the numbers of species documented in these and the present study are plotted against the log-transformed size of the area surveyed (Fig. 10), a highly significant positive correlation is obtained ($r = 0.934$, $P < 0.01$, $df = 5$). As the size of the area increases, the number of species present increases in a corresponding manner. This suggests the results of the present study are in line with other herpetological surveys conducted in the region. Totaling 37 species on an area of 223 ha, our results compare most closely to those of the Haynes Bottom Wildlife Management Area inventory (Scott and Williamson 1999) in which 35 species were documented on a tract of 393 ha that borders the Cumberland River some 43 km upstream from FODO in southwestern Montgomery County, Tennessee.

Possible Influence of Climate on Results

Climatic conditions of temperature and precipitation at FODO during the period of this study (September 2003 through August 2005) were compared to those having occurred from 1970 through 2000. Overall annual averages for temperatures during the two periods (14.6 °C vs. 14.0 °C, respectively) were not significantly different ($t = 0.18$, $df = 22$, $P = 0.86$), with average monthly means closely approximating each other during most of the annual cycle (Fig. 4). Likewise, overall averages of monthly precipitation (9.3 cm vs. 11.3 cm) were not significantly different ($t = 1.57$, $df = 22$, $P = 0.13$); however eight of the 12 individual monthly averages for the period of this study were below the averages for the same months during the 20-year comparison period (Fig. 5). Four of these lower-than-normal monthly averages for precipitation came during the winter (December, January, February, and March) when vernal ponds are normally filling with water and one came in May when many amphibians (especially anurans) begin their breeding periods and reptiles are emerging from winter dormancy. Had

rainfall been closer to normal during these months, the total number of species and individuals detected might have been greater.

CONCLUSIONS

The results of this study lead to a number of conclusions concerning the herpetofauna of Fort Donelson National Battlefield and the techniques used to sample it.

1) Failure to document more than 66% of the species that were expected to occur on the area doesn't necessarily suggest inadequate sampling effort. Instead, it probably reflects the fact most of the taxa beyond those considered "highly likely to occur" are rare or habitat-limited in the region thus more difficult to detect.

2) Of the various sampling techniques employed during the study, plot sampling and the drift fence proved to be the most efficient at documenting species and making individual captures. However, had road cruising, haphazard searching, stream searches, and the tin transect not been used, over a third of the taxa documented would have been missed.

3) The species richness of Fort Donelson's herpetofauna as documented in this study is proportionately in line with that of other areas that have been studied in the region. A direct linear correlation exists between the number of species documented and size of the area that was sampled.

4) Although speculative, the lack of precipitation during this study as compared to the long-term average for the area might have contributed to the lower-than-expected number of species found on the area.

5) Instituting a long-term monitoring program for amphibians and reptiles at Fort Donelson National Military Park is recommended using the data from this study as the baseline for evaluating changes in herpetofaunal richness, community composition, and relative abundance.

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

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

Table 2. Number of trips, total miles driven, and total man hours expended on trips to the study area (FODO) each month during the period of systematic sampling (1 January 2004 through 31 August 2005).

Year/Month	No. trips	Miles driven	Man hours expended
2004			
January	3	225	23.50
February	6	485	28.75
March	8	622	38.20
April	8	636	37.65
May	5	395	37.20
June	7	582	64.00
July	7	573	61.00
August	8	613	40.75
September	11	873	60.20
October	8	629	40.90
November	8	603	36.60
December	2	161	10.25
2005			
January	4	281	17.25
February	7	522	33.00
March	5	386	22.25
April	4	301	26.75
May	3	220	20.00
June	4	296	25.75
July	5	389	39.50
August	6	431	34.19
Totals	119	9223	695.01

Table 3. Numbers of times per month over the study period that each sampling technique was used while inventorying the amphibians and reptiles of Fort Donelson National Battlefield near Dover, Tennessee.

Year/Month	Sampling techniques					
	Random plots	Tin transect	Drift fence	Search of stream reaches	Haphazard searches	Road cruising
2004						
January	2	-	3	1	-	3
February	2	-	6	3	-	6
March	2	2	4	3	4	8
April	2	6	8	3	3	8
May	2	3	3	3	1	5
June	3	5	5	3	2	7
July	3	5	7	2	1	7
August	2	4	5	4	2	8
September	4	7	8	4	1	11
October	3	5	6	2	1	8
November	3	5	7	1	1	8
December	1	1	2	2	1	2
2005						
January	1	1	2	1	1	4
February	2	3	5	2	5	7
March	2	2	3	3	4	5
April	2	2	4	2	2	4
May	2	2	2	2	2	3
June	2	2	2	1	2	4
Overall	40	55	82	42	33	108

Table 4. Species of amphibians and reptiles documented from January 2004 through August 2005 at Fort Donelson National Battlefield along with sampling methods (DF= Drift Fence, HS = Haphazard Searches, RC = Road Cruising, RP = Random Plots, SS= Stream Searches, and TT= Tin Transect) detected by and numbers of individuals encountered overall and in each major habitat recognized on the area.

Species	Sampling method(s)	Major habitats				Totals
		Stream or streamside	Pond	Field	Forest	
Salamanders						
<i>Notophthalmus viridescens</i> - Eastern Newt	RC	0	0	1	0	1
<i>Ambystoma maculatum</i> - Spotted Salamander	DF, RC	0	1	0	1	2
<i>Desmognathus conanti</i> - Spotted Dusky Salamander	SS	15	0	0	0	15
<i>Eurycea cirrigera</i> - Southern Two-lined Salamander	SS, RP	7	0	0	0	7
<i>Eurycea lucifuga</i> - Cave Salamander	HS, RP	1	0	1	1	3
<i>Plethodon dorsalis</i> – Northern Zigzag Salamander	DF, HS, RP	0	0	0	74	74
<i>Plethodon glutinosus</i> - Northern Slimy Salamander	DF, RP	0	0	0	39	39
Subtotals		23	1	2	115	141
Frogs or toads						
<i>Acris crepitans</i> - Northern Cricket Frog	HS	2	0	0	0	2
<i>Bufo americanus</i> - American Toad	DF, HS, RC, RP, TT	1	9	0	19	29
<i>Bufo fowleri</i> - Fowler's Toad	ALL	4	21	5	24	54
<i>Hyla versicolor</i> complex - Gray Treefrog	RC	0	0	0	2	2
<i>Hyla cinerea</i> - Green Treefrog	RC, RP	1	0	1	7	9
<i>Pseudacris crucifer</i> - Spring Peeper	HS	0	6	0	0	6
<i>Pseudacris feriarum</i> - Southeastern Chorus Frog	HS	0	8	0	3	11
<i>Rana catesbeiana</i> – Bullfrog	DF, HS, SS	2	2	0	0	4
<i>Rana clamitans</i> - Green Frog	RC	0	0	0	1	1
<i>Rana sphenoccephala</i> - Southern Leopard Frog	DF, HS, RP, SS	5	13	0	3	21
Subtotals		15	59	6	59	139
Turtles						
<i>Terrapene carolina</i> - Eastern Box Turtle	HS, RC, RP, TT	2	0	3	36	41
<i>Trachemys scripta</i> - Pond Slider	HS, RC, RP	2	0	0	3	5
Subtotals		4	0	3	39	46
Lizards						
<i>Sceloporus undulatus</i> - Fence Lizard	DF, HS, RC, RP, TT	0	0	2	7	9
<i>Eumeces fasciatus</i> - Five-lined Skink	HS, RP	0	0	1	3	4
<i>Eumeces laticeps</i> - Broad-headed Skink	DF, RP	0	0	0	2	2
<i>Scincella lateralis</i> – Little Brown Skink	HS, RP	0	0	2	13	15
Subtotals		0	0	5	25	30
Snakes						
<i>Agkistrodon contortrix</i> – Copperhead	RC	0	0	0	1	1
<i>Carphophis amoenus</i> - Eastern Wormsnake	RP, TT	0	0	0	4	4
<i>Coluber constrictor</i> - Eastern Racer	HS, RC, RP, TT	0	0	9	5	14
<i>Diadophis punctatus</i> - Ring-necked Snake	RP, TT	0	0	5	17	22
<i>Lampropeltis getula</i> - Common Kingsnake	RC, RP, TT	0	0	8	5	13
<i>Lampropeltis triangulum</i> – Milksnake	RC	0	0	0	1	1
<i>Nerodia sipedon</i> - Common Watersnake	HS, SS	2	0	0	0	2
<i>Opheodrys aestivus</i> - Rough Greensnake	RC	0	0	0	1	1
<i>Pantherophis spiloides</i> - Central Ratsnake	RC	0	0	0	1	1
<i>Regina septemvittata</i> - Queen Snake	SS	1	0	0	0	1
<i>Storeria dekayi</i> - Dekay’s Brownsnake	TT	0	0	2	0	2
<i>Storeria occipitomaculata</i> - Red-bellied Snake	TT	0	0	1	0	1
<i>Thamnophis sirtalis</i> - Common Gartersnake	RC, RP	1	0	0	1	2
<i>Virginia valeriae</i> - Smooth Earthsnake	RP, TT	0	0	9	3	12
Subtotals		4	0	34	39	77
Grand Totals for All Species		46	60	50	277	433

Table 5. Totals for the numbers of specimens and species detected by each of the six sampling methods used during an inventory of amphibians and reptiles at Fort Donelson National Battlefield near Dover, Tennessee, January 2004 through August 2005.

Sampling method	Total no. of individuals found	Total no. of species found	No. of species found only by this method
Random plots	134	20	0
Drift fence	107	9	0
Road cruising	53	17	6
Tin transect	45	11	2
Haphazard searching	41	15	2
Searches along streams	30	9	2

Table 6. Details of results of plot sampling for amphibians and reptiles at Fort Donelson National Battlefield from 1 January 2004 through 31 August 2005. Numerals in columns below plot numbers indicate the number of individuals of each species recorded per plot for each species and overall. Totals for each species along with frequency of occurrence and relative frequency are given in the last three columns.

Species	Plot number															Tot.	Freq.	Rel. freq.
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15			
<i>Plethodon glutinosus</i> - Northern Slimy Salamander	1	6	2	-	6	7	-	3	6	-	-	2	-	-	-	33	53	13.9
<i>Diadophis punctatus</i> - Ring-necked Snake	-	2	-	2	1	3	-	1	8	-	-	-	-	-	-	17	40	10.5
<i>Plethodon dorsalis</i> - Northern Zigzag Salamander	7	2	-	-	-	8	-	-	2	-	5	-	-	-	1	25	40	10.5
<i>Scincella lateralis</i> - Little Brown Skink	3	-	3	-	-	1	1	1	-	-	-	-	-	-	1	10	40	10.5
<i>Terrapene carolina</i> - Eastern Box Turtle	1	2	3	-	-	4	-	-	-	-	1	-	1	-	-	12	40	10.5
<i>Bufo americanus</i> - American Toad	-	-	3	-	2	-	-	1	-	-	-	1	-	-	-	7	27	7.1
<i>Bufo fowleri</i> - Fowler's Toad	-	-	-	-	-	3	-	-	3	-	-	-	2	-	-	8	20	5.2
<i>Lampropeltis getula</i> - Common Kingsnake	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	3	20	5.2
<i>Carphophis amoenus</i> - Eastern Wormsnake	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	13	3.4
<i>Coluber constrictor</i> - Eastern Racer	-	2	-	-	-	-	-	-	-	1	-	-	-	-	-	3	13	3.4
<i>Virginia valeriae</i> - Smooth Earth Snake	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	3	13	3.4
<i>Eumeces fasciatus</i> - Five-lined Skink	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	7	1.8
<i>Eumeces laticeps</i> - Broad-headed Skink	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	7	1.8
<i>Eurycea cirrigera</i> - Southern Two-lined Salamander	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	7	1.8
<i>Eurycea lucifuga</i> - Cave Salamander	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	1.8
<i>Hyla cinerea</i> - Green Treefrog	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	7	1.8
<i>Rana sphenoccephala</i> - Southern Leopard Frog	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	7	1.8
<i>Sceloporus undulatus</i> - Fence Lizard	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	7	1.8
<i>Thamnophis sirtalis</i> - Common Gartersnake	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	7	1.8
<i>Trachemys scripta</i> - Pond Slider	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	7	1.8
Totals	15	14	11	3	10	28	2	6	23	2	6	3	7	2	2	134	382	99.8

Table 7. List of areas, other than Fort Donelson National Battlefield, in the lower Cumberland drainage basin that have been inventoried for amphibians and reptiles, along with author(s) of each study, date report was filed or published, size or area (ha) surveyed, and number of species documented.

Area inventoried	Study's author(s)	Year of report	Size of area (ha)	No. species documented
Montgomery County	Scott and Snyder	1967	140,634	58
Land Between The Lakes	Snyder	1972	68,799	66
Fort Campbell Military Reservation	Zirkle	1993	42,699	48
Haynes Bottom Wildlife Management Area	Scott and Williamson	1999	393	35
Shelton Ferry Wetland	Rozelle and Scott	1995	176	34
Dunbar Cave State Natural Area	Fitch	1998	44	26
Barnette Woods Natural Area	Scott	1991	28	25

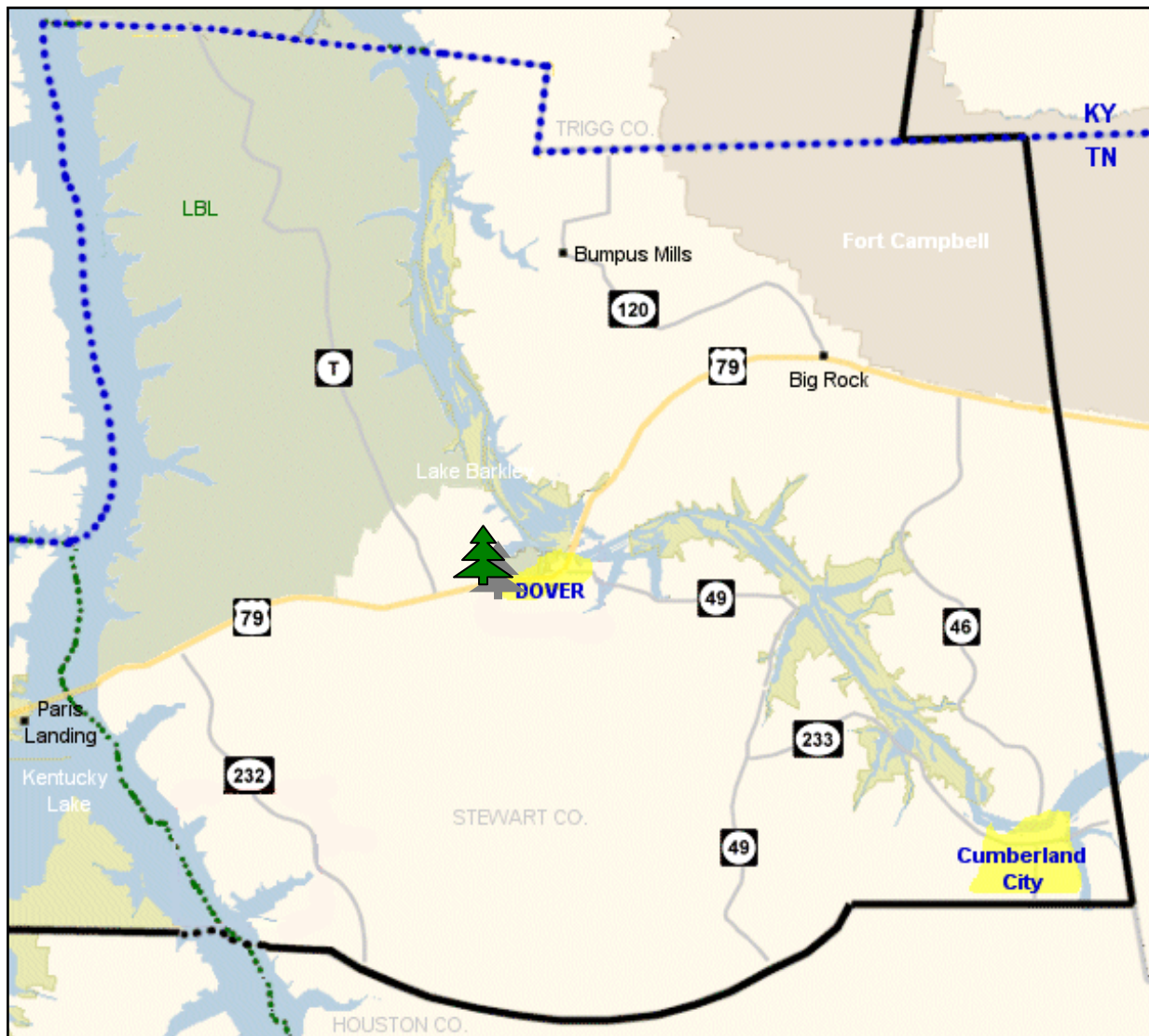


Figure 1. Location of Fort Donelson (tree symbol) one mile west of Dover, in Stewart County, Tennessee.

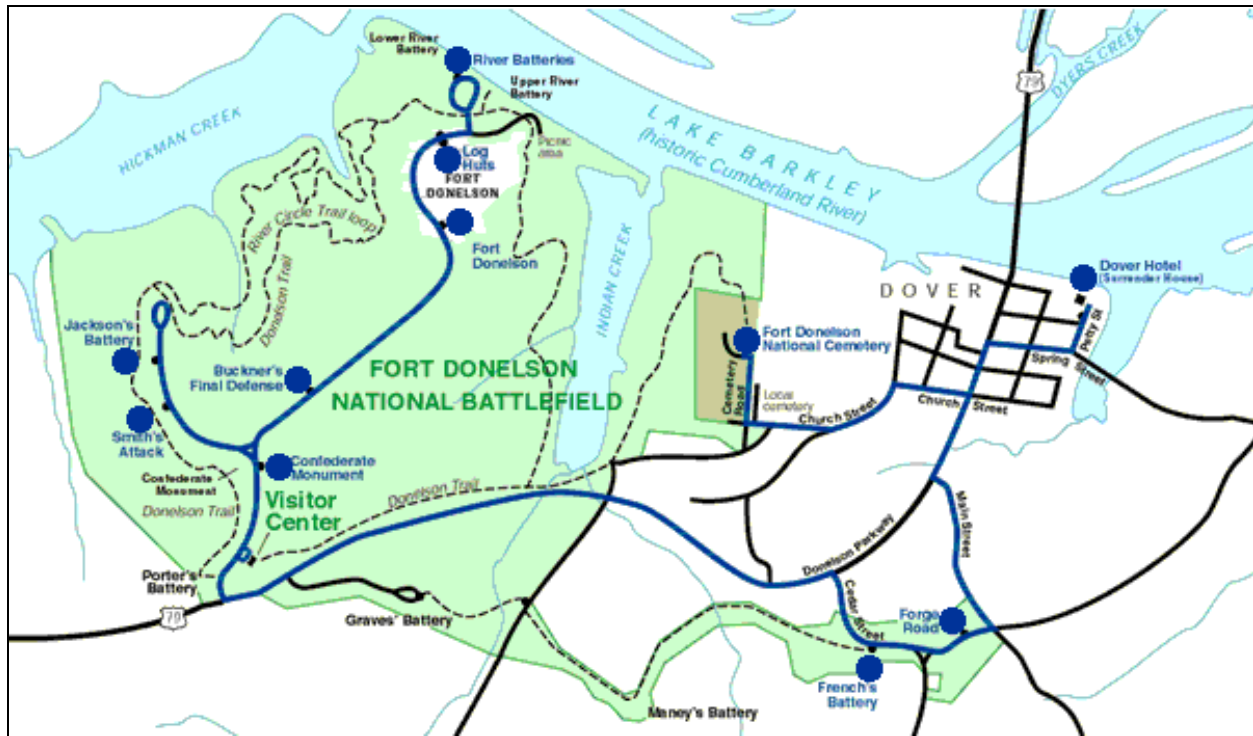


Figure 2. Selected features within Fort Donelson National Battlefield in relation to surrounding roads, towns, and waterways. Map courtesy of the United States National Park Service.



Figure 3. Satellite image of Fort Donelson showing park boundary (red line), varied topography, and major cover types. Photo provided by the United States National Park Service.

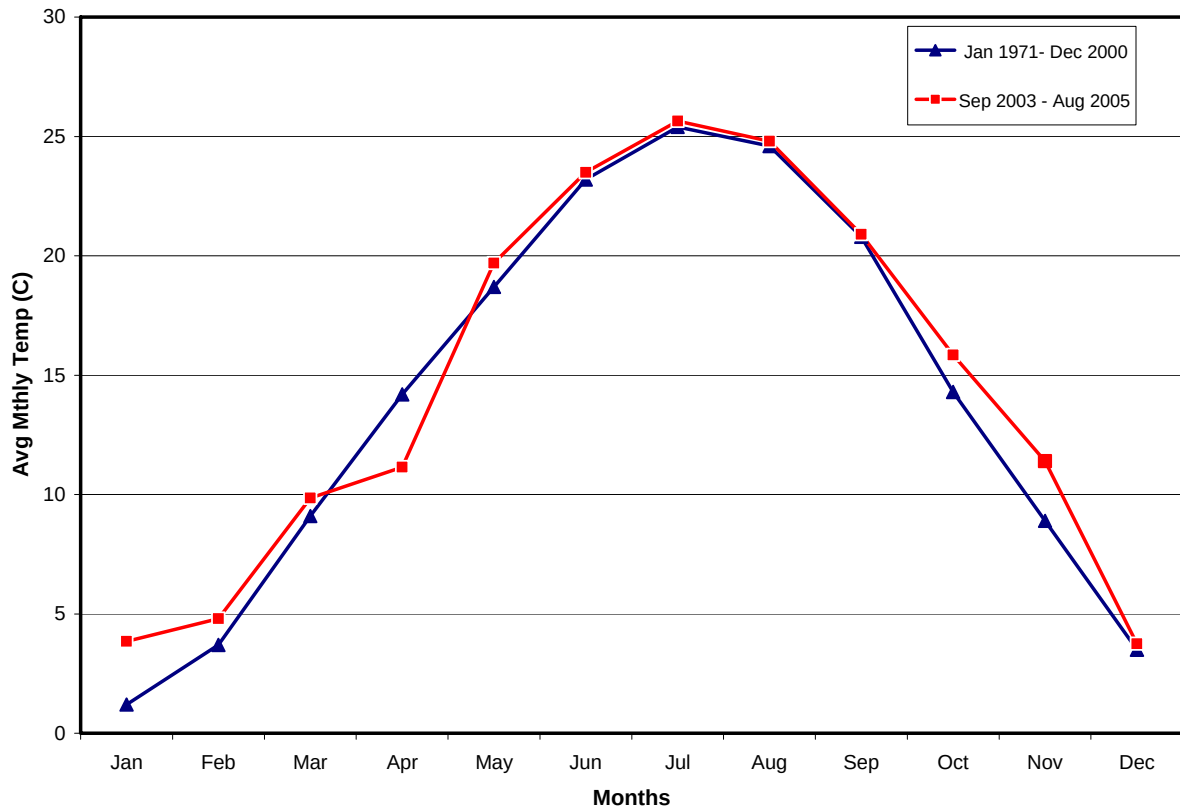


Figure 4. Comparison of the mean monthly temperatures at Fort Donelson National Battlefield during the period of this study (September 2003 through August 2005) with that for the 30-year period beginning January 1971 and ending December 2000.

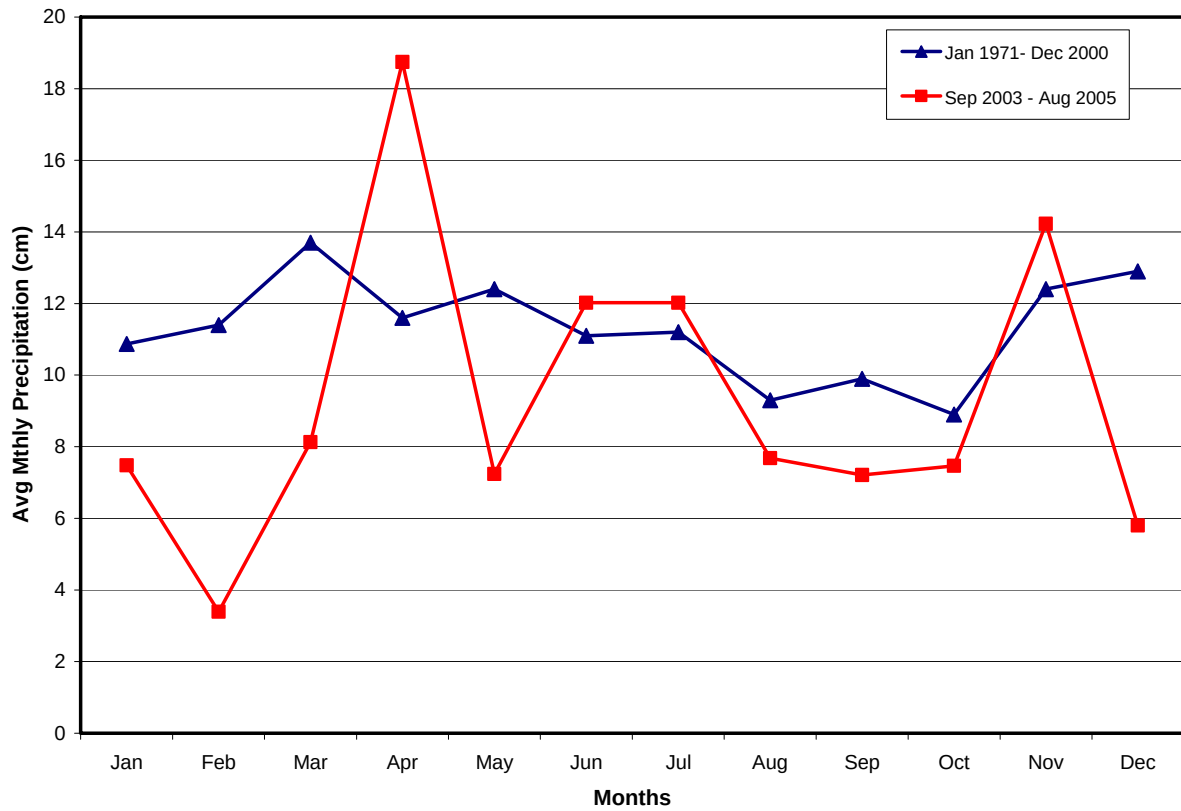


Figure 5. Comparison of the means for average total monthly precipitation at Fort Donelson National Battlefield during the period of this study (September 2003 through August 2005) with that for the 30-year period beginning January 1971 and ending December 2000.

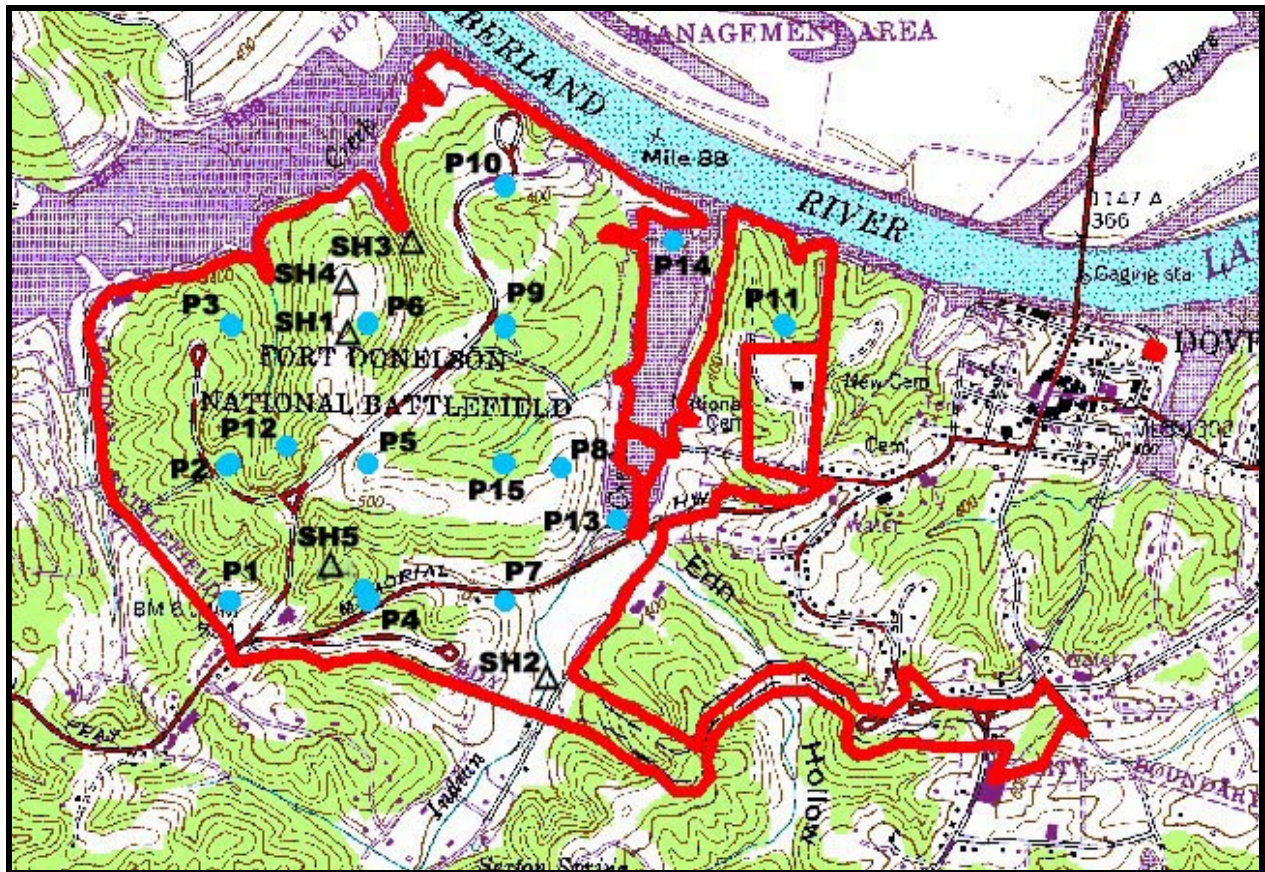
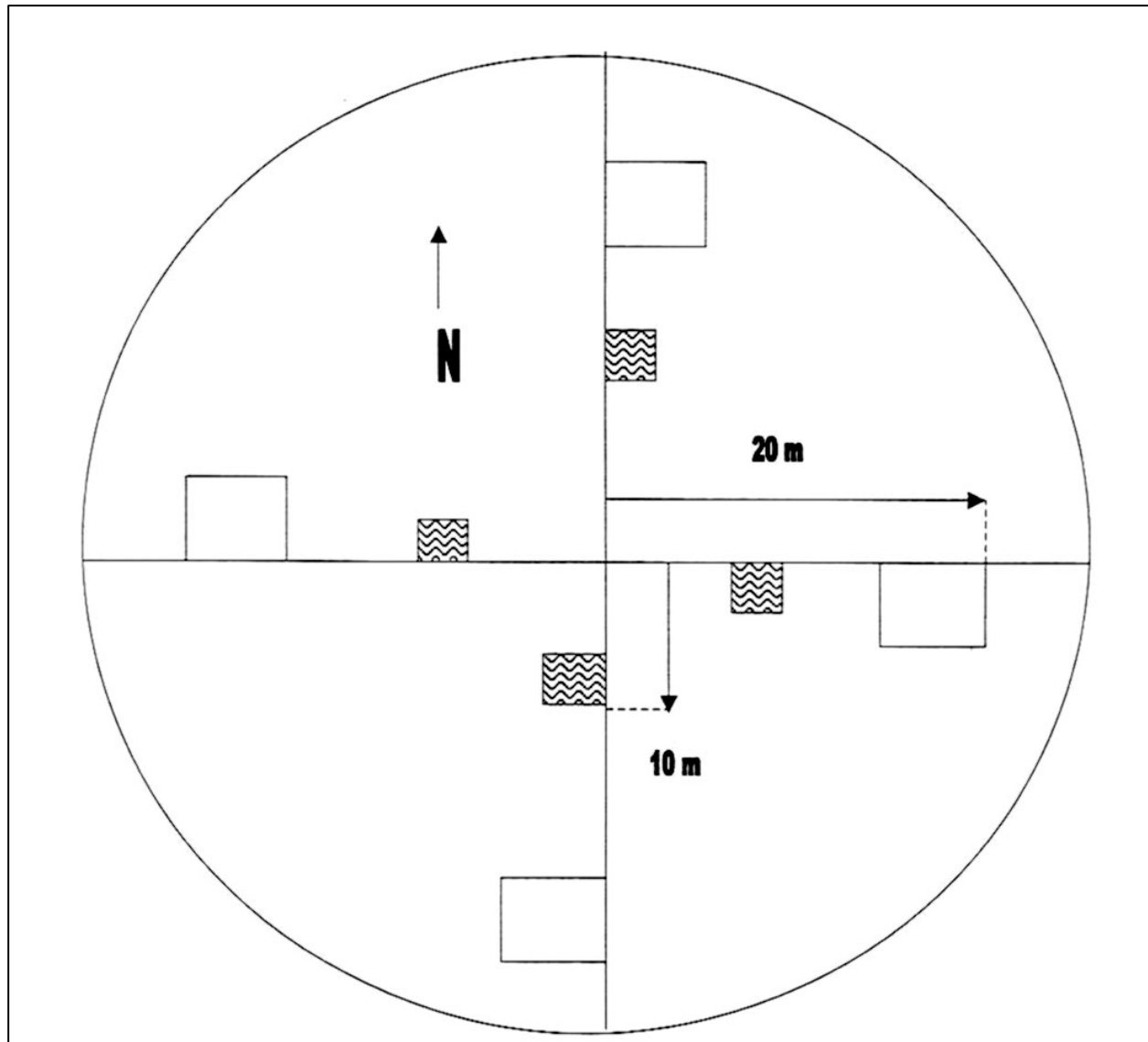


Figure 6. Topographical map of the Dover, Tennessee area showing the boundary of Fort Donelson National Battlefield (red line) and locations of 15 random plots (blue dots) and five special habitats (open triangles) identified for use in this study.



 Cover objects (roofing tin and plyboard)
  8x8 m constrained-search-area subplots

Figure 7. Diagram of the 1-ha random plot showing the location of the four 8x8 m constrained-search plots and the four cover boards (NPS, 2003).

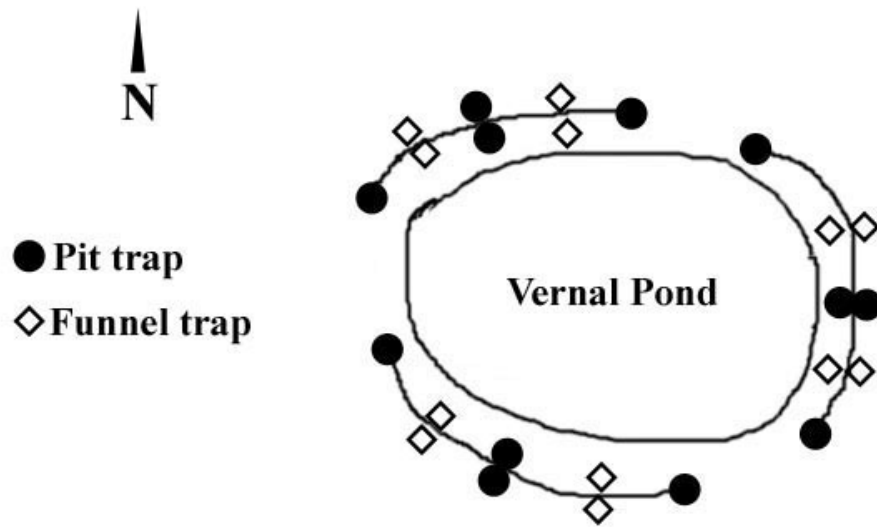


Figure 8. Layout of discontinuous drift fence (with pit and funnel traps) used to sample amphibians and reptiles moving to and from the vernal pond located at 36.4896°N, 87.8608°W in Fort Donelson National Battlefield.

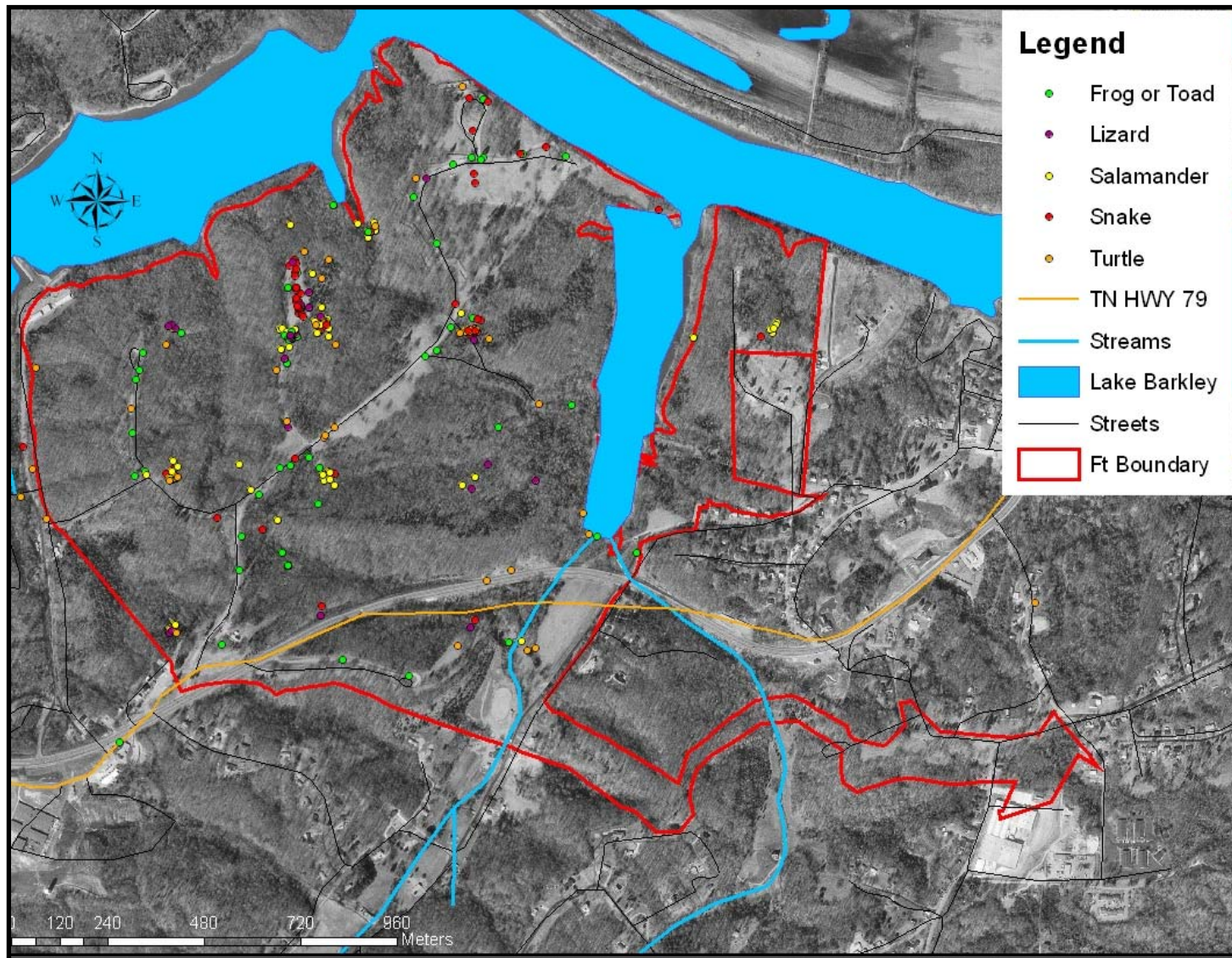


Figure 9. Distribution of the records logged for species in the five major herpetofaunal groups documented at Fort Donelson National Battlefield from 1 January 2004 through 31 August 2005.

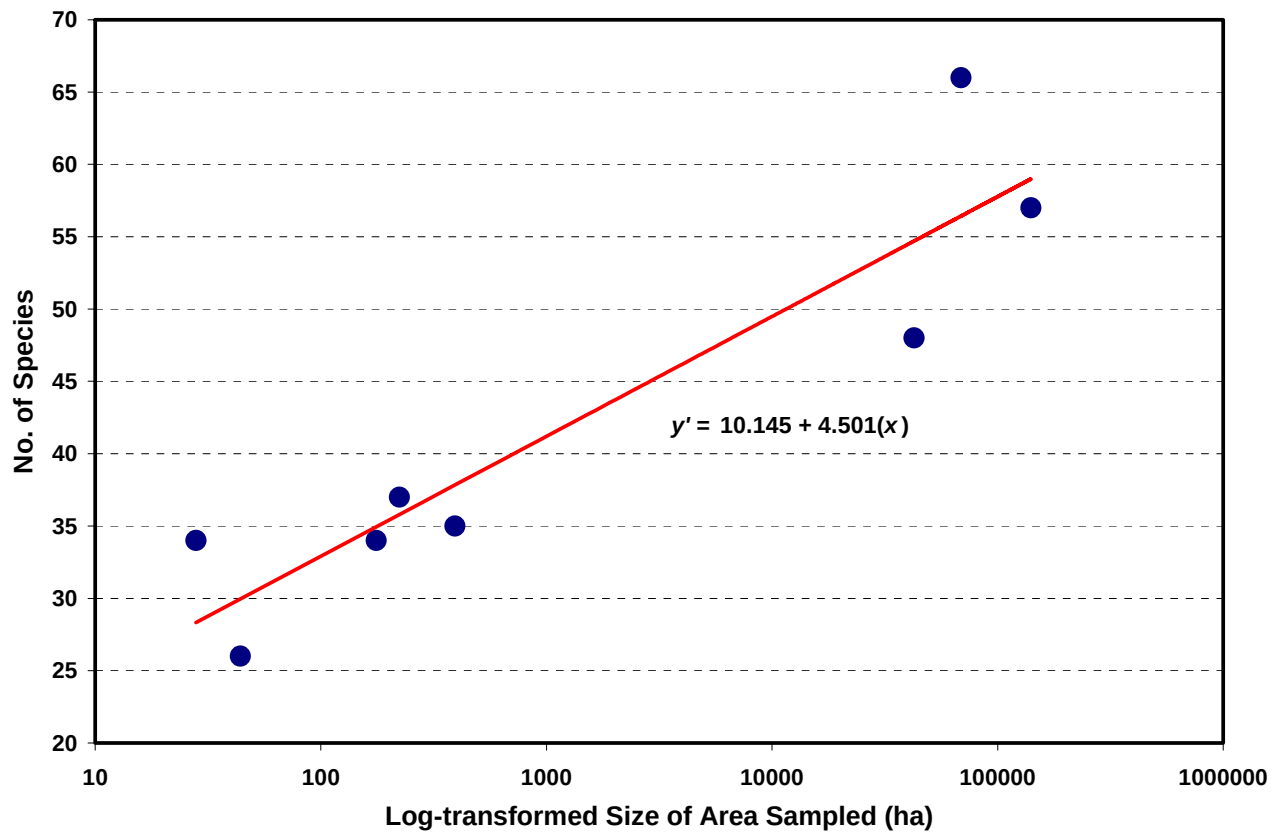


Figure 10. Relationship between the size of area sampled (after log transformation) and the number of species detected during inventories of the herpetofauna of eight different tracts in the lower Cumberland River Basin. See Table 7 for tract names, authors of project reports, and years reports were published or submitted.

APPENDICES

Appendix A. Names, identifying codes, UTM coordinates, and brief descriptions of prevailing plant communities at permanent sampling sites established during an inventory of the amphibians and reptiles of Fort Donelson National Battlefield, 1 January 2004 through 31 August 2005.

Site Name	Site code	Coordinates (UTM, Zone 16)	Plant community type
Random Plot No.1	P1	422581E, 4037835N	Successional, red cedar
Random Plot No.2	P2	422578E, 4038205N	Ridge forest, white-oak
Random Plot No.3	P3	422591E, 4038574N	Dry to mesic oak-hickory
Random Plot No.4	P4	422965E, 4037844N	Road bank, shrubs, mixed canopy
Random Plot No.5	P5	422960E, 4038209N	Mesic lower slope, oak-American beech
Random Plot No.6	P6	422956E, 4038584N	Late successional, tulip tree
Random Plot No.7	P7	423328E, 4037834N	Mixed forest and field
Random Plot No.8	P8	423321E, 4038208N	Successional, oak-tulip tree
Random Plot No.9	P9	423328E, 4038571N	Successional, tulip tree
Random Plot No.10	P10	423330E, 4038955N	Mowed field
Random Plot No.11	P11	424079E, 4038577N	Forest, oak-tulip tree with sassafras-paw paw understory
Random Plot No.12	P12	422738E, 4038249N	Forest, white oak-American beech
Random Plot No.13	P13	423634E, 4038057N	Mixed bottomland communities
Random Plot No.14	P14	423781E, 4038804N	Mixed bottomland communities
Random Plot No.15	P15	423482E, 4038200N	Successional, planted pine
Special Habitat No. 1	SH1	422900E, 4038599N	Woodland pond, ephemeral
Special Habitat No. 2	SH2	423427E, 4037616N	First-order stream
Special Habitat No. 3	SH3	423037E, 4038849N	Intermittent stream
Special Habitat No. 4	SH4	422881E, 4038686N	Field with grasses, forbs, and scattered small trees
Special Habitat No. 5	SH5	422865E, 4037989N	Ephemeral pool along steep gradient intermittent stream

APPENDIX B
Maps Showing Locations Where Each Species Was Documented
(Order of presentation is alphabetical by species binomial)

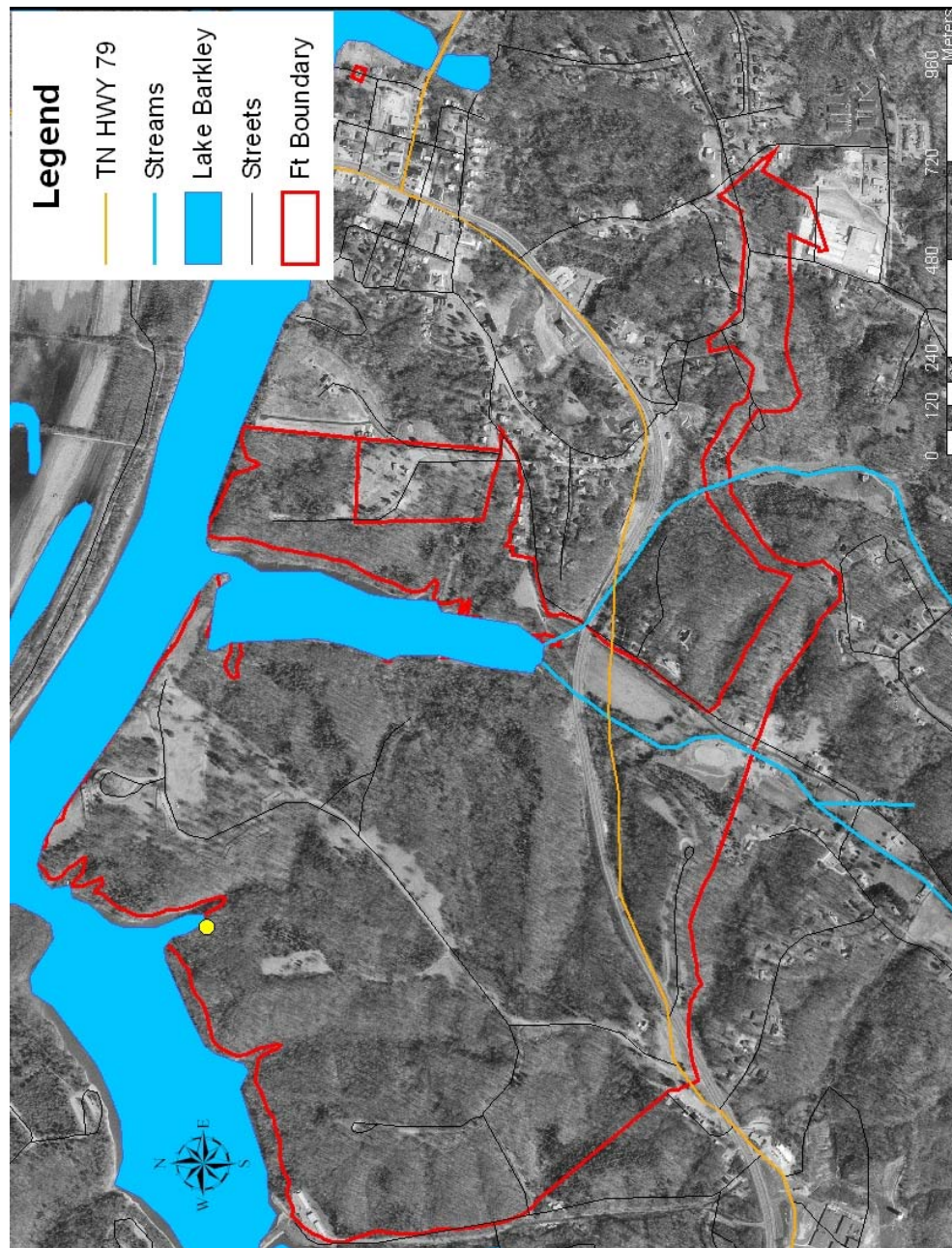


Figure A-2. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Acris crepitans* was documented, January 2004 through August 2005.

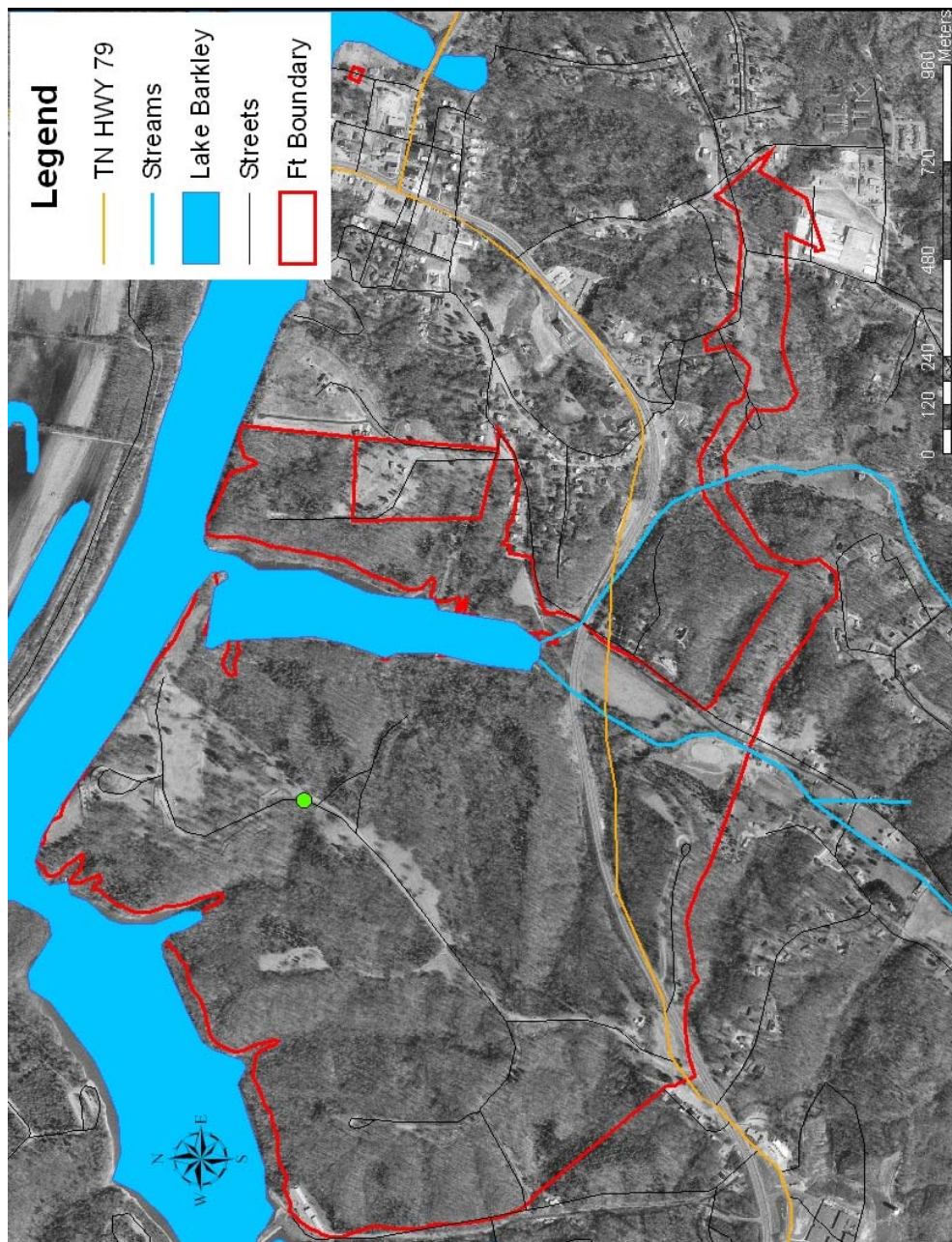


Figure A-3. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Agkistrodon contortrix* was documented, January 2004 through August 2005.

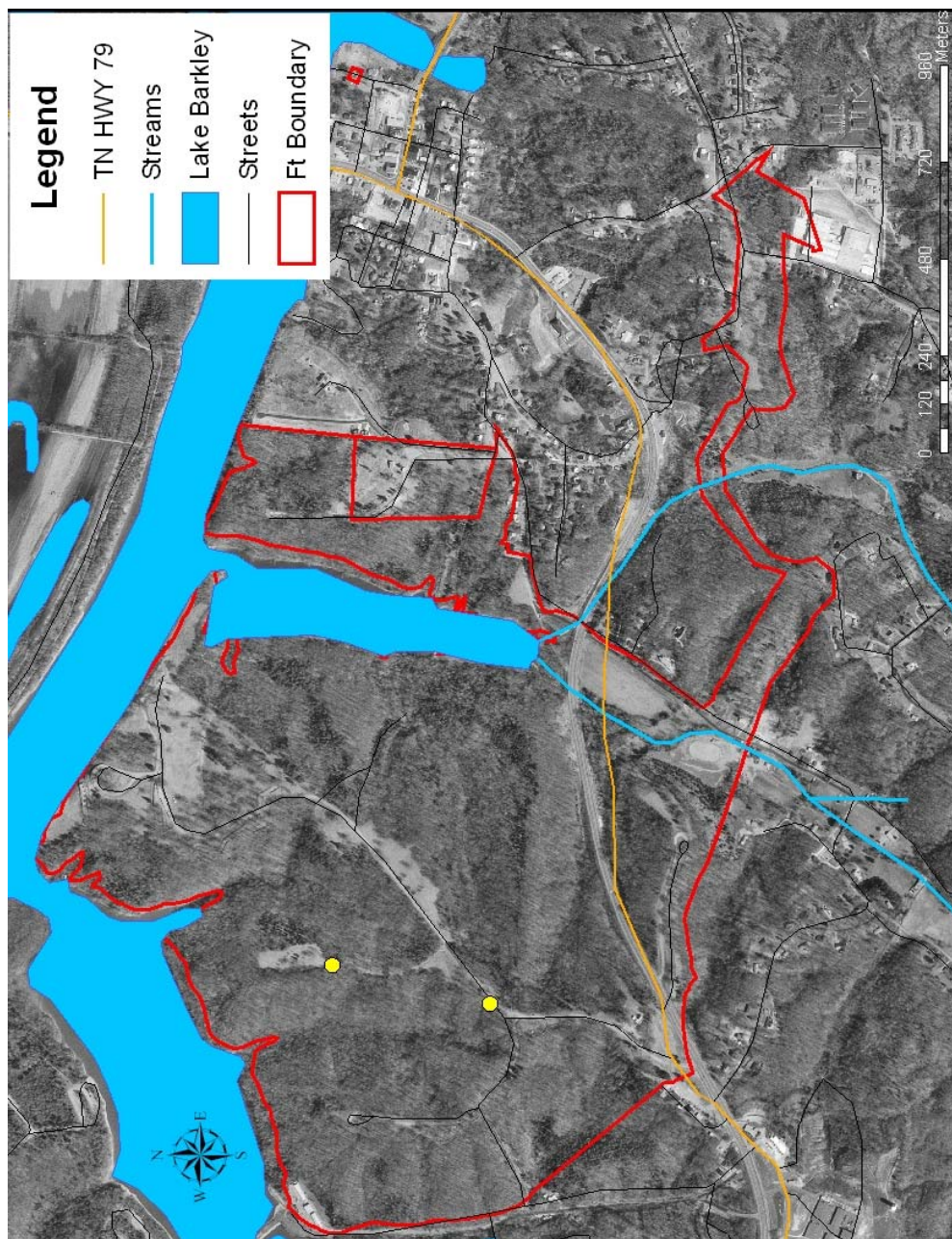


Figure A-4. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Ambystoma maculatum* was documented, January 2004 through August 2005.

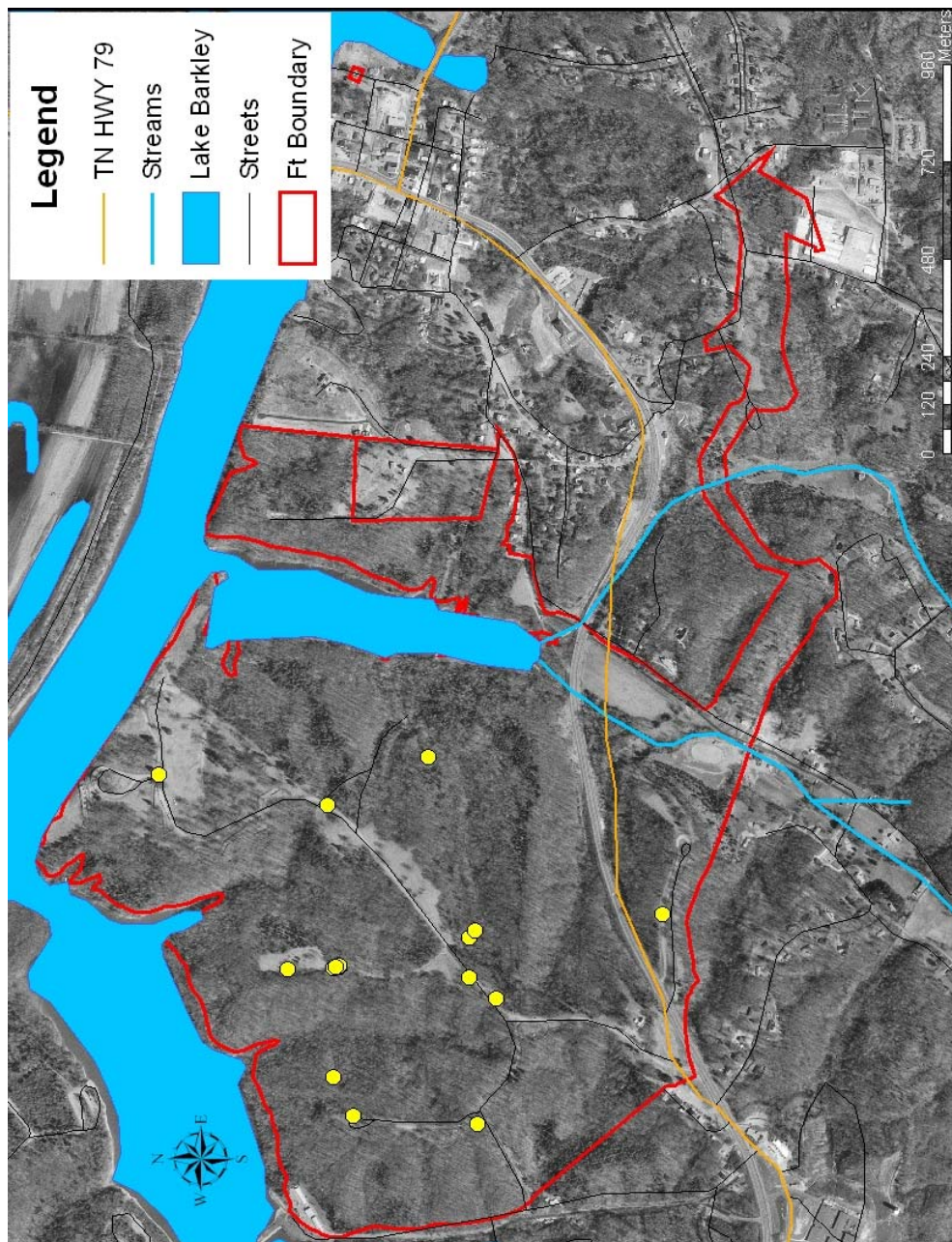


Figure A-5. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Bufo americanus* was documented, January 2004 through August 2005.

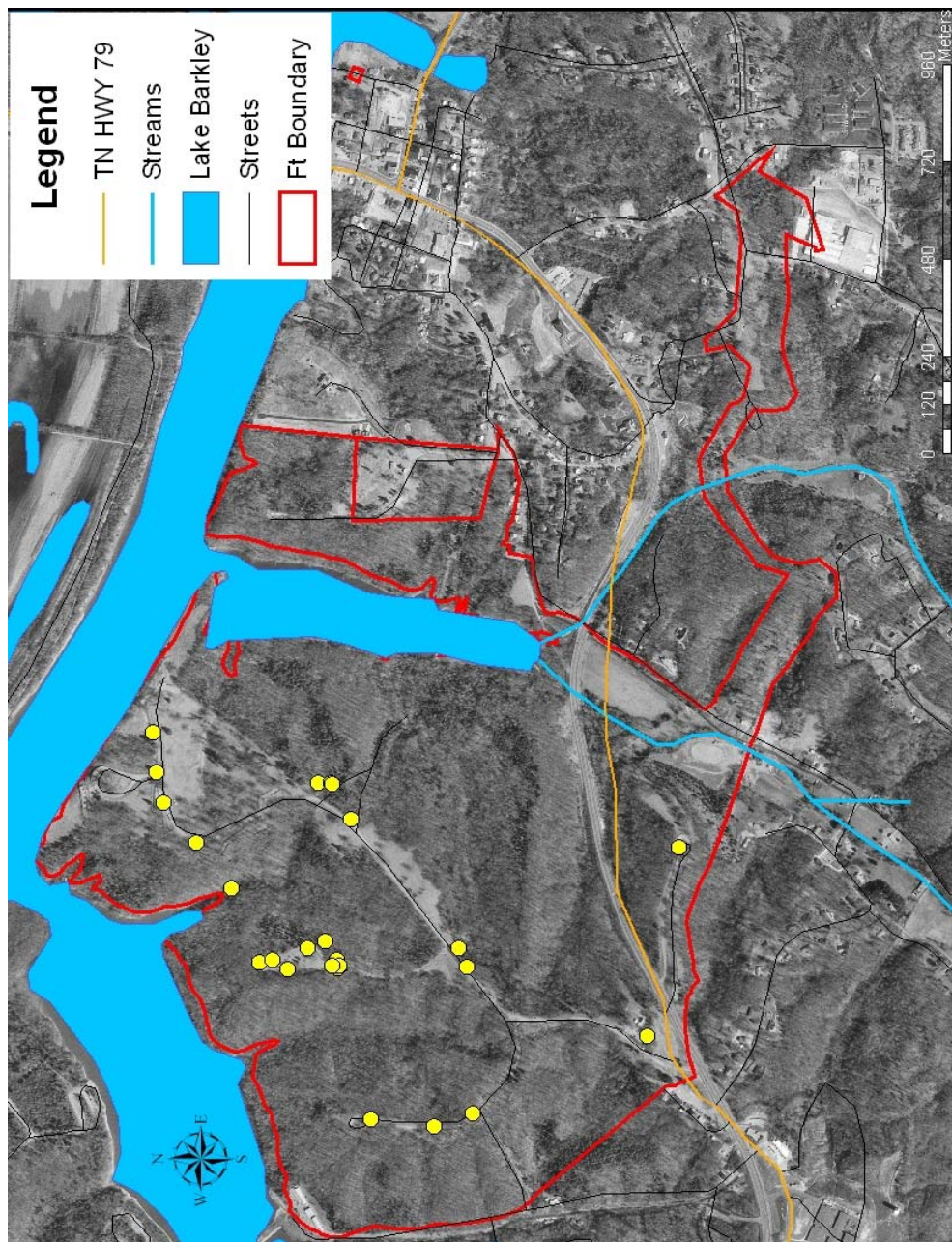


Figure A-6. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Bufo fowleri* was documented, January 2004 through August 2005.

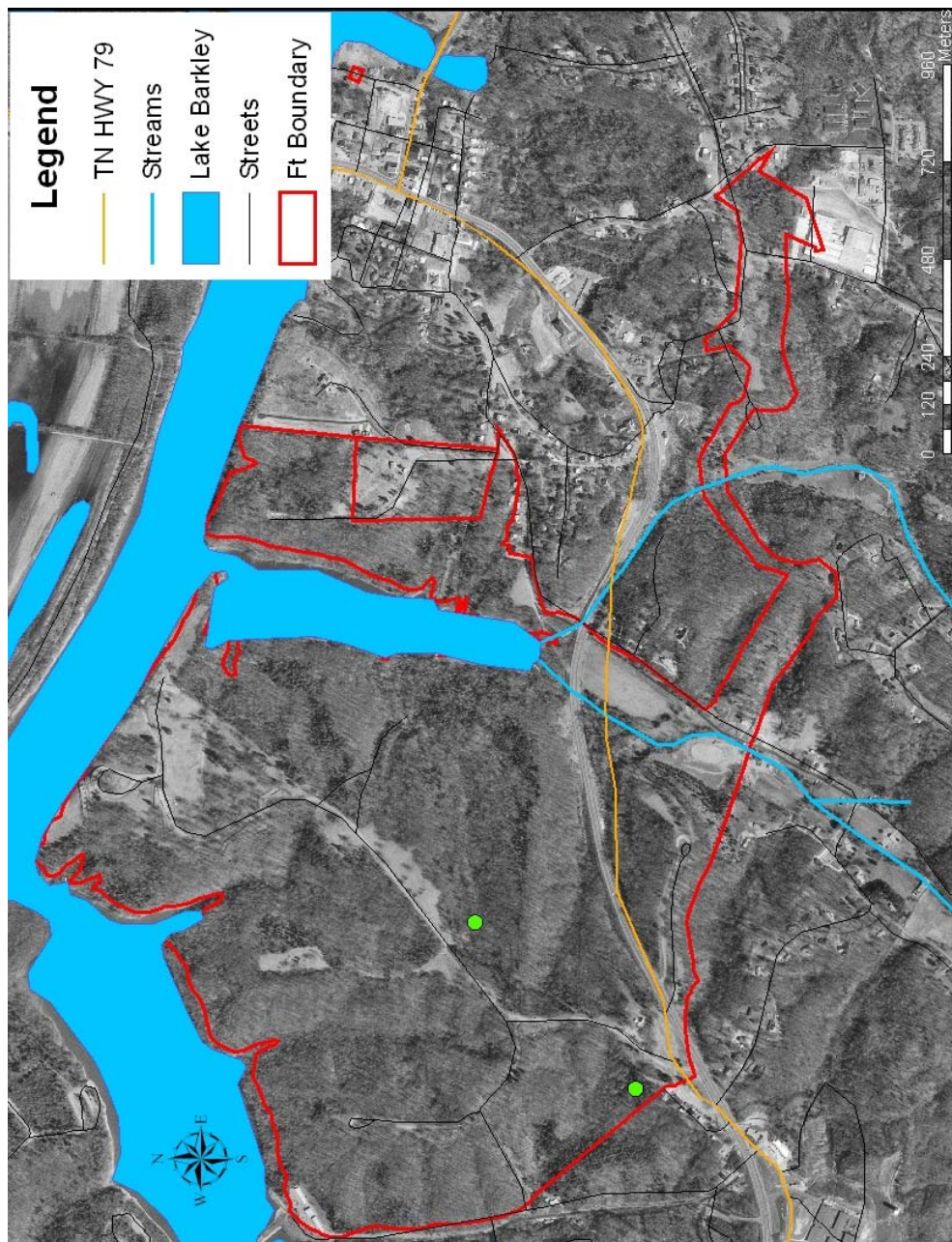


Figure A-7. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Carphophis amoenus* was documented, January 2004 through August 2005.

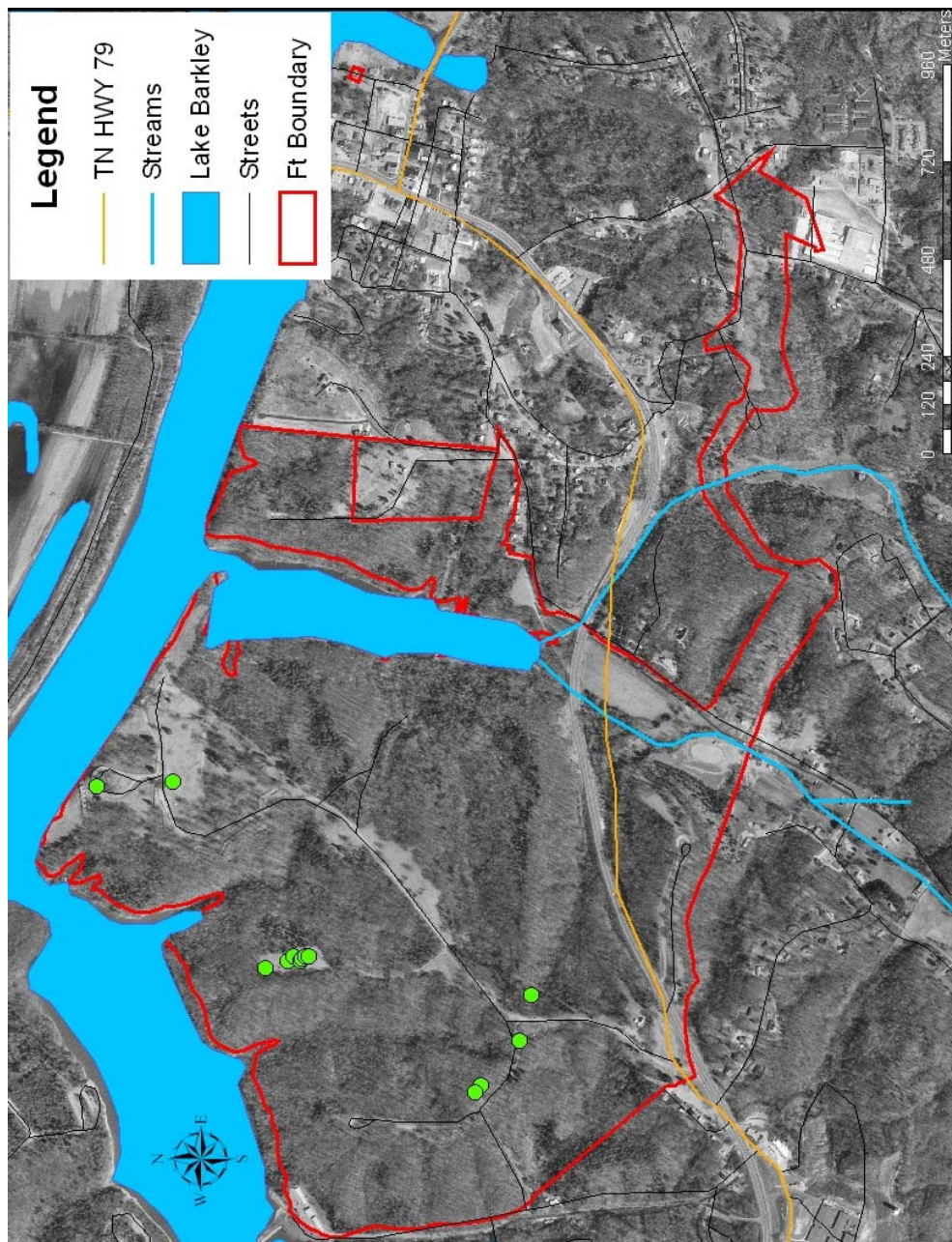


Figure A-8. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Coluber constrictor* was documented, January 2004 through August 2005.

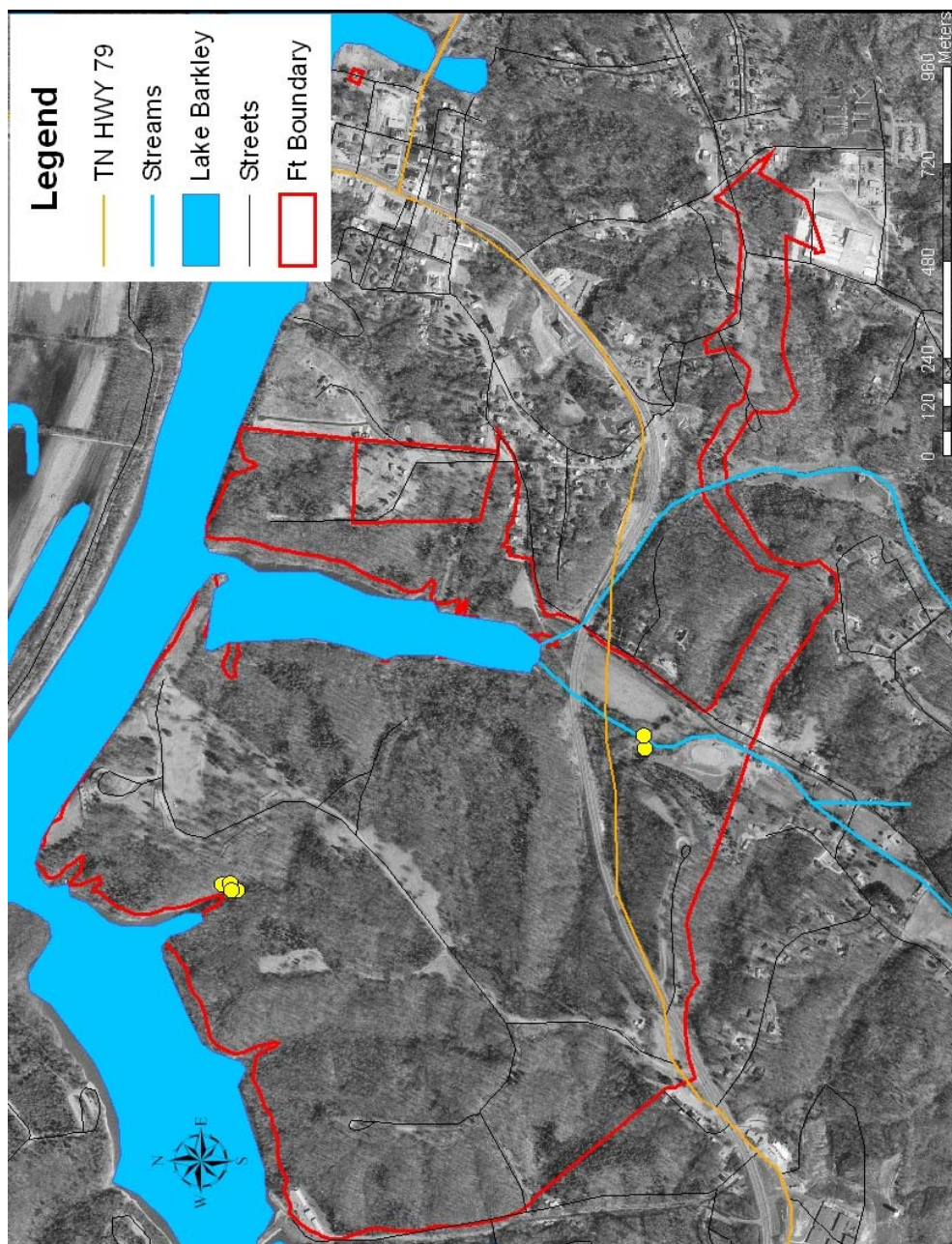


Figure A-9. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Desmognathus conanti* was documented, January 2004 through August 2005.

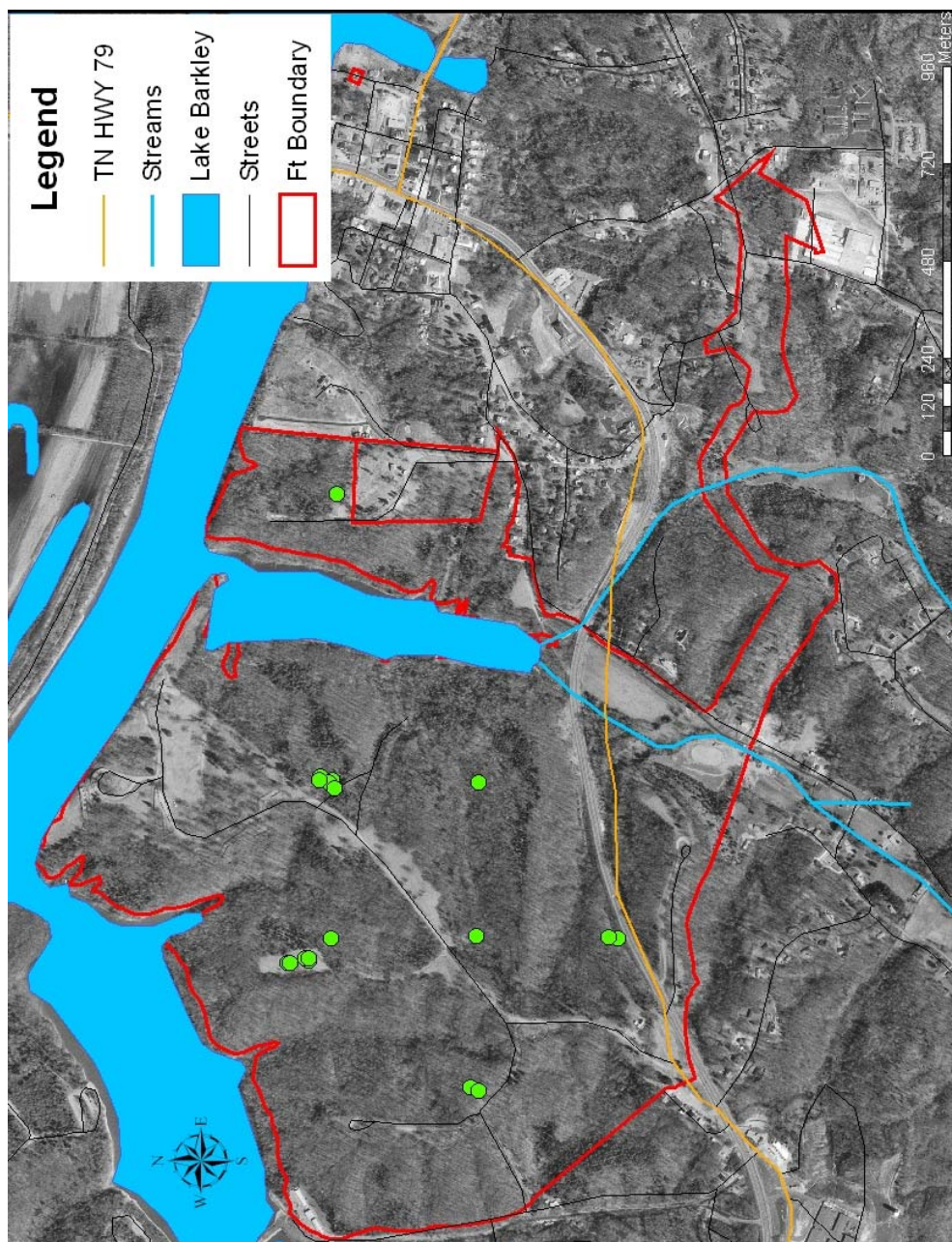


Figure A-10. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Diadophis punctatus* was documented, January 2004 through August 2005.

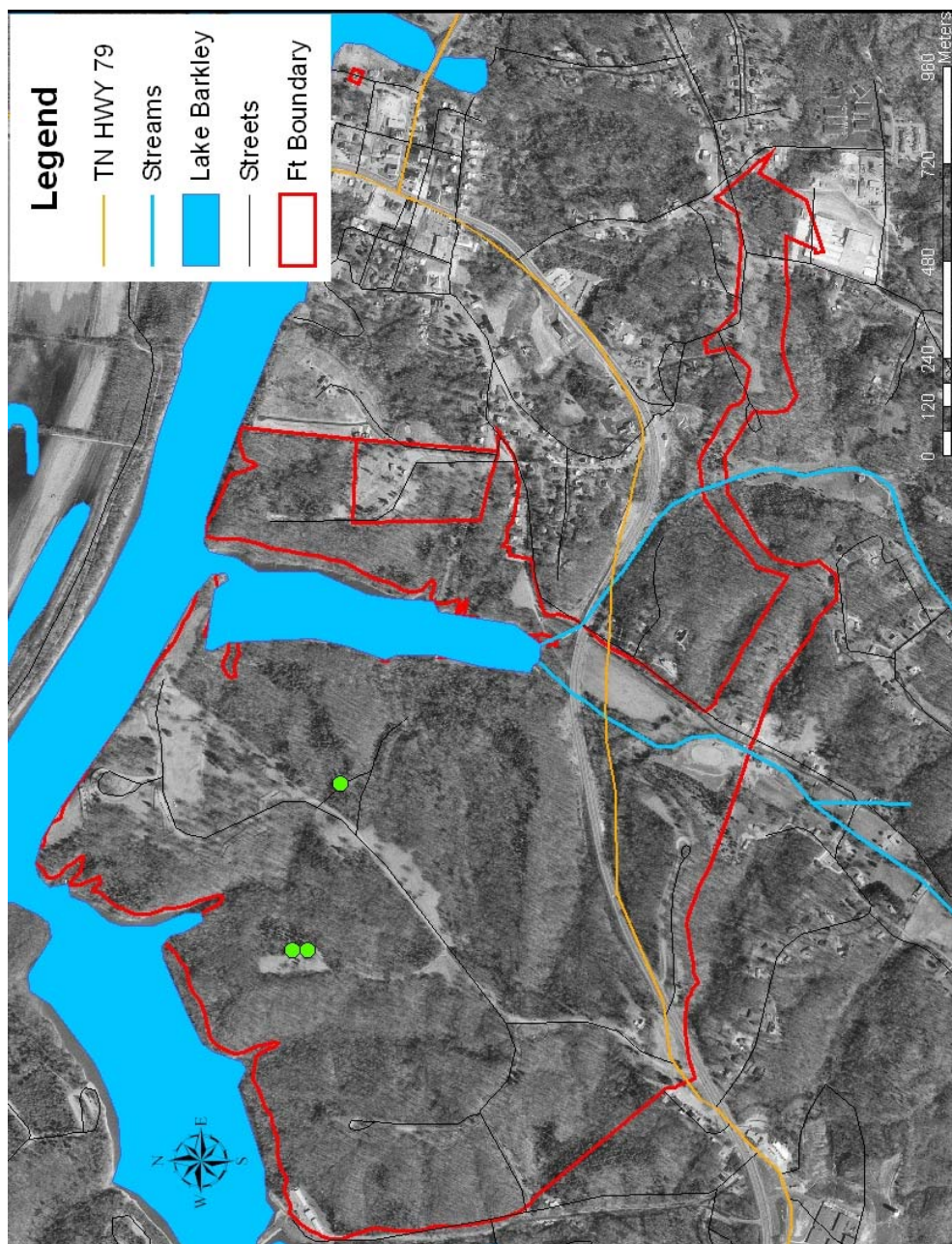


Figure A-11. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Eumeces fasciatus* was documented, January 2004 through August 2005.

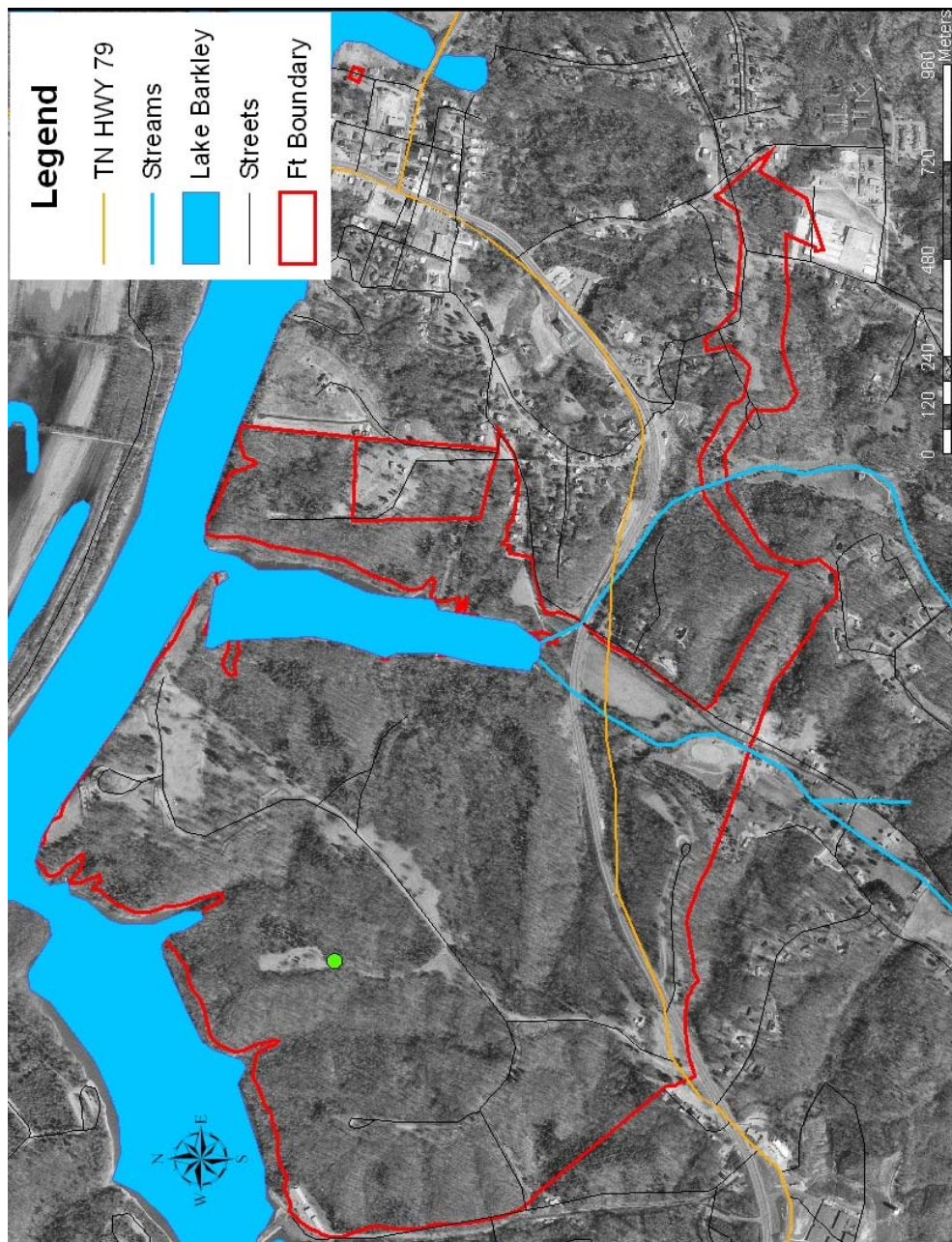


Figure A-12. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Eumeces laticeps* was documented, January 2004 through August 2005.

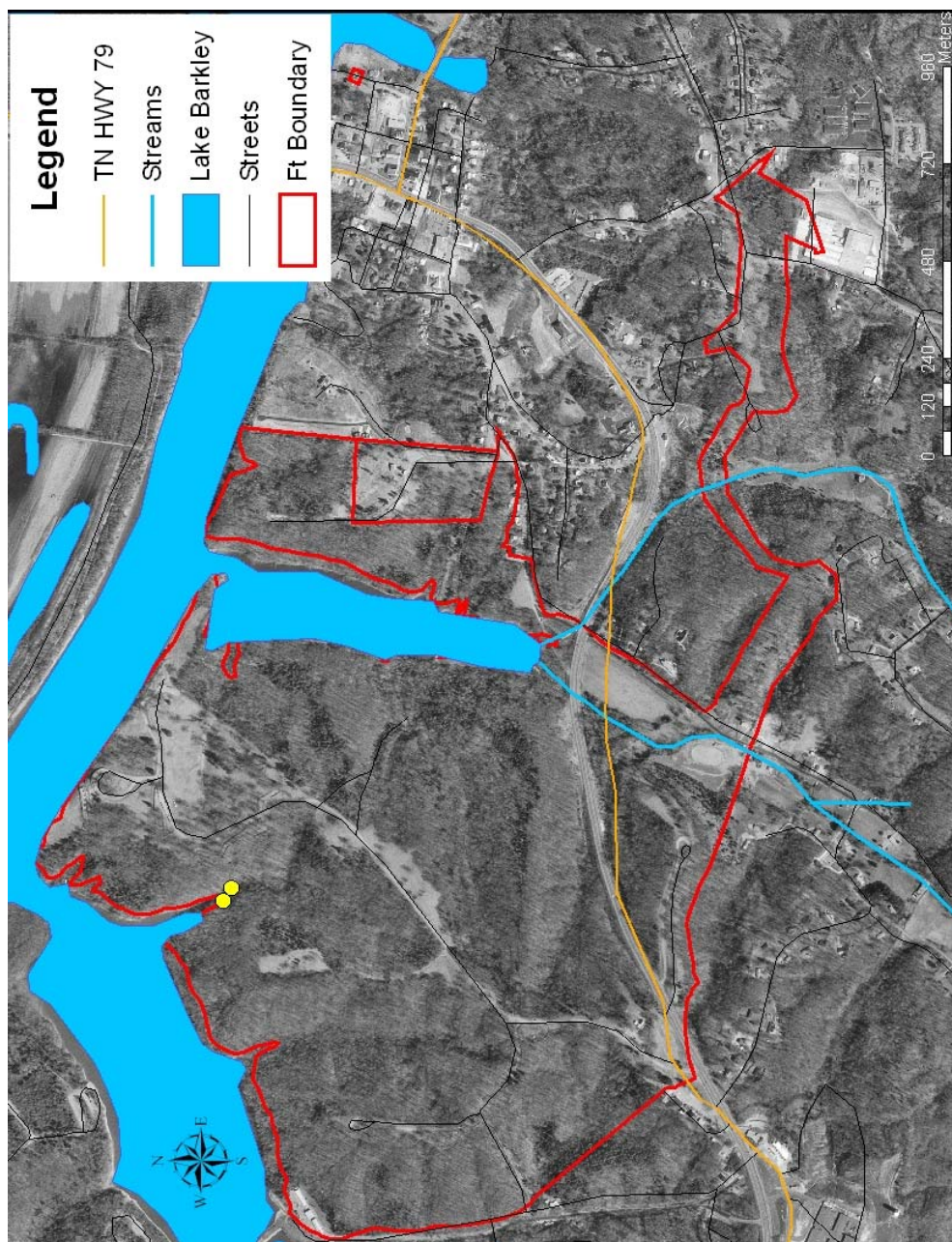


Figure A-13. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Eurycea cirrigera* was documented, January 2004 through August 2005.

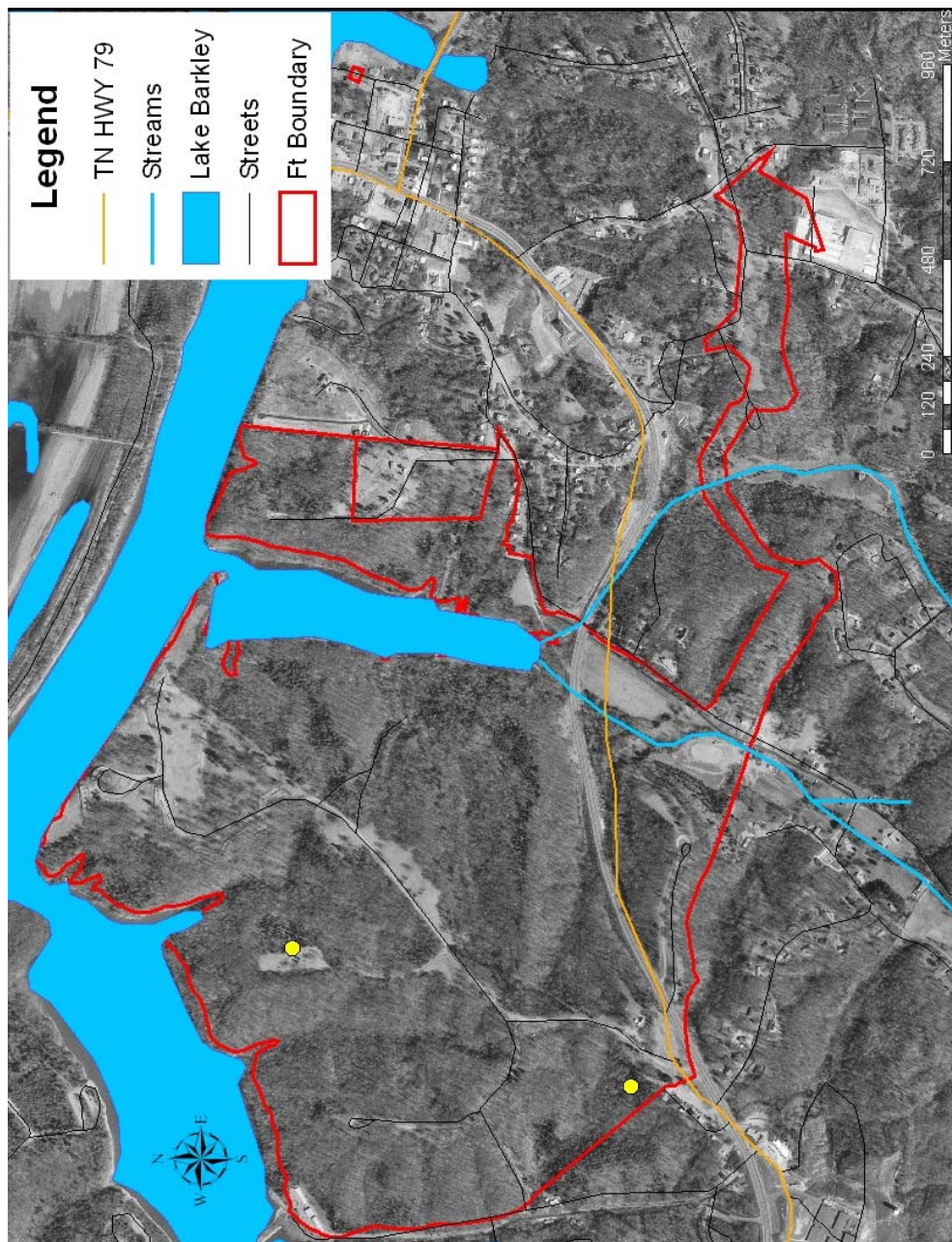


Figure A-14. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Eurycea lucifuga* was documented, January 2004 through August 2005.

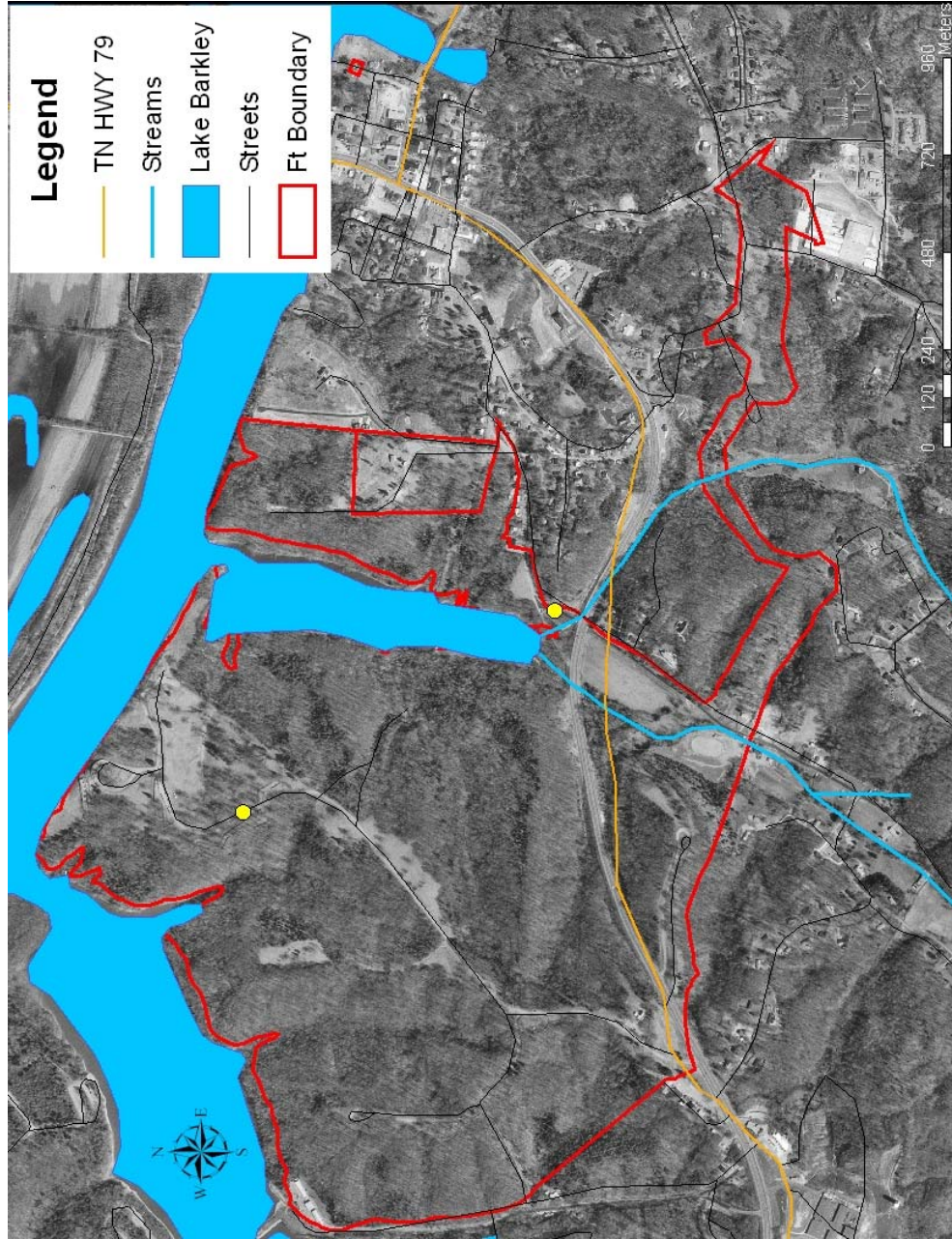


Figure A-15. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where specimens of the *Hyla versicolor* complex were documented, January 2004 through August 2005.

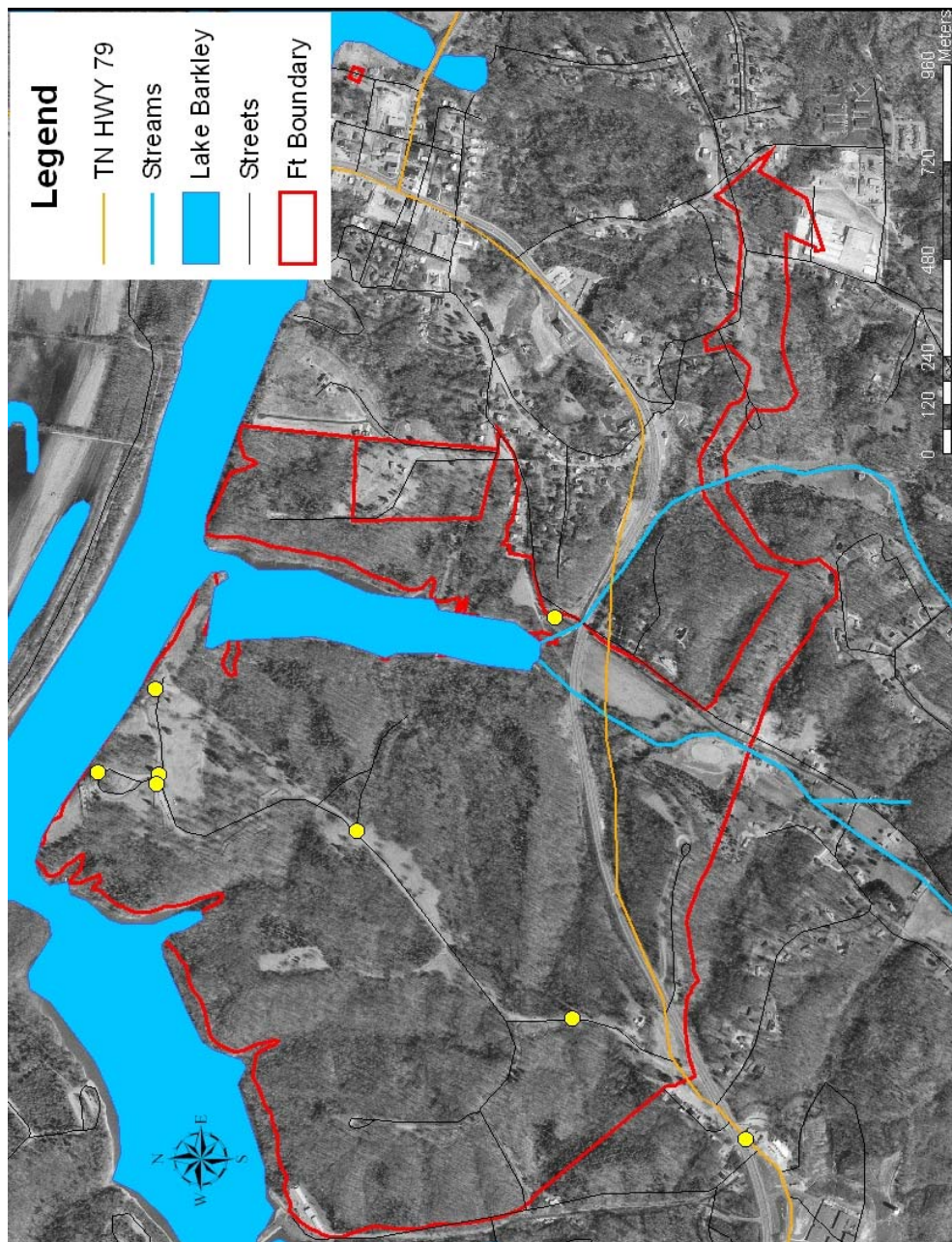


Figure A-16. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Hyla cinerea* was documented, January 2004 through August 2005.

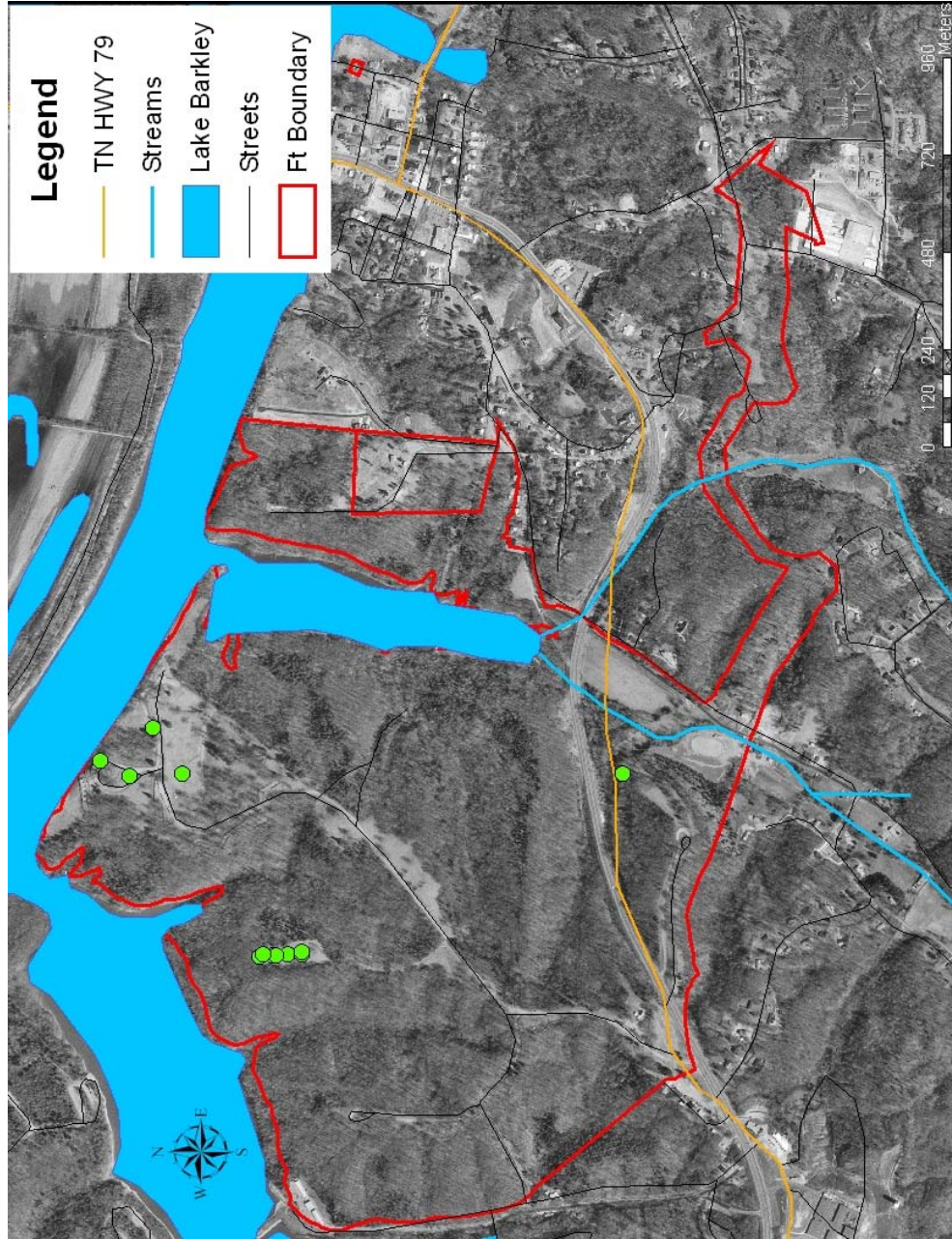


Figure A-17. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Lampropeltis getula* was documented, January 2004 through August 2005.

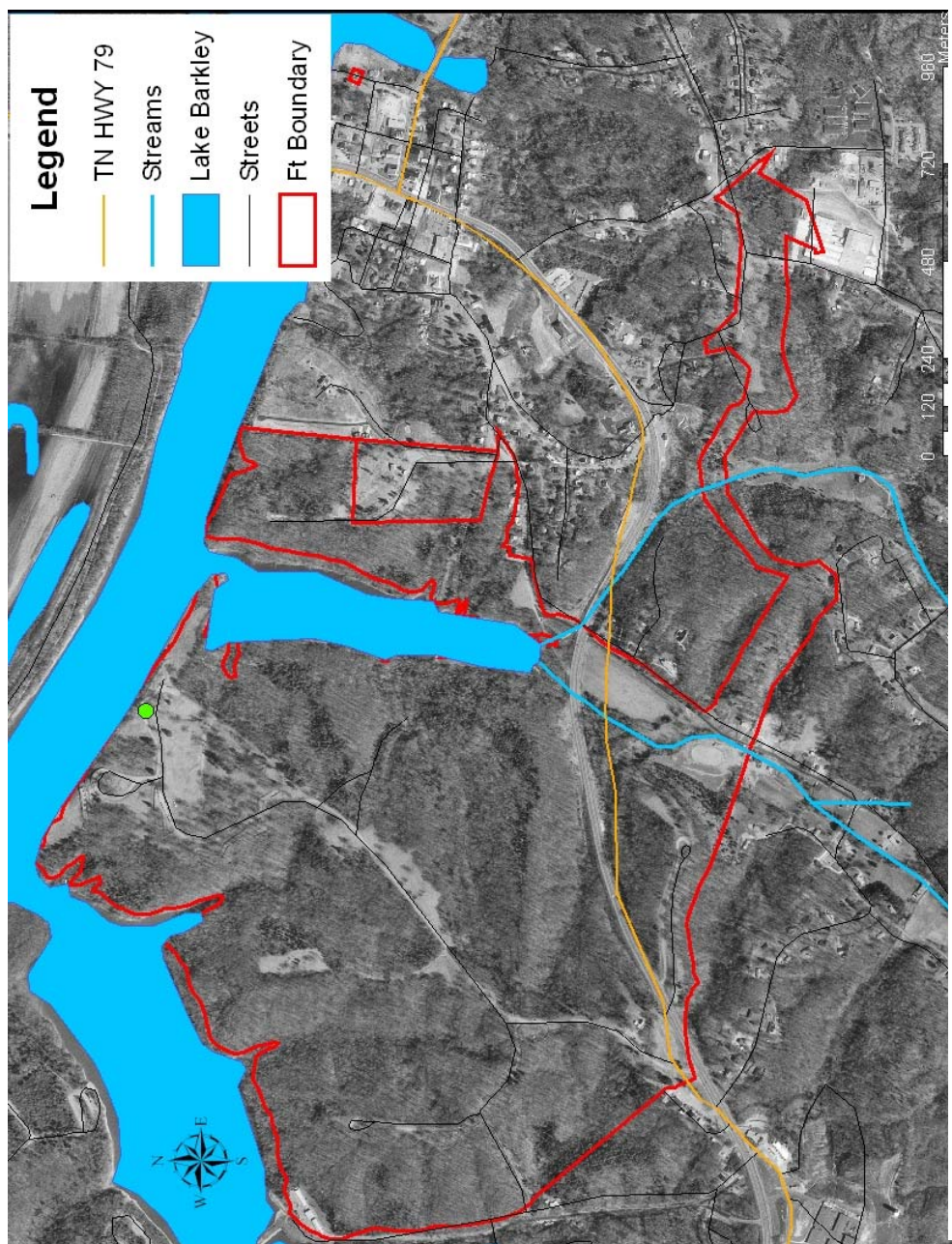


Figure A-18. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Lampropeltis triangulum* was documented, January 2004 through August 2005.

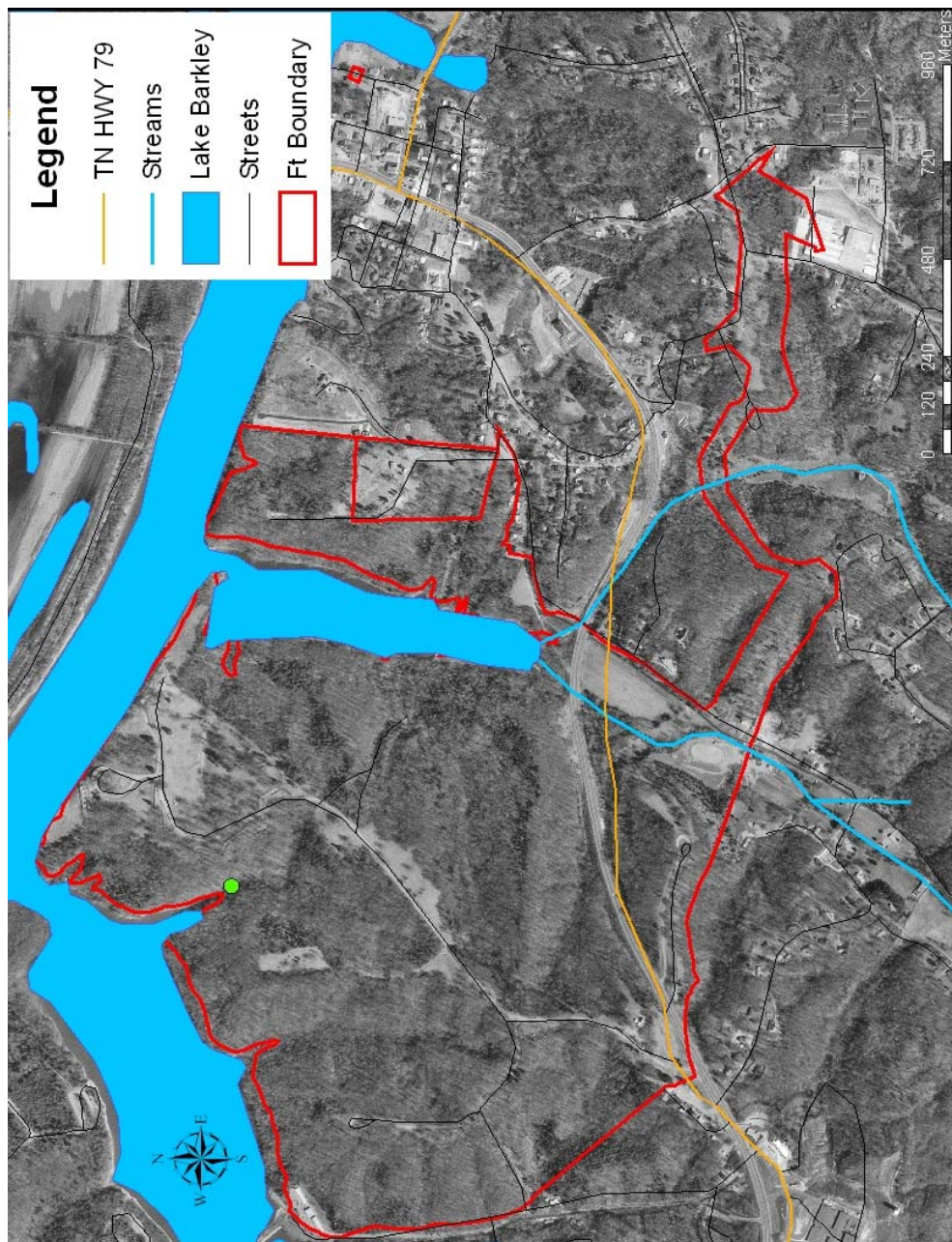


Figure A-19. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Nerodia sipedon* was documented, January 2004 through August 2005.

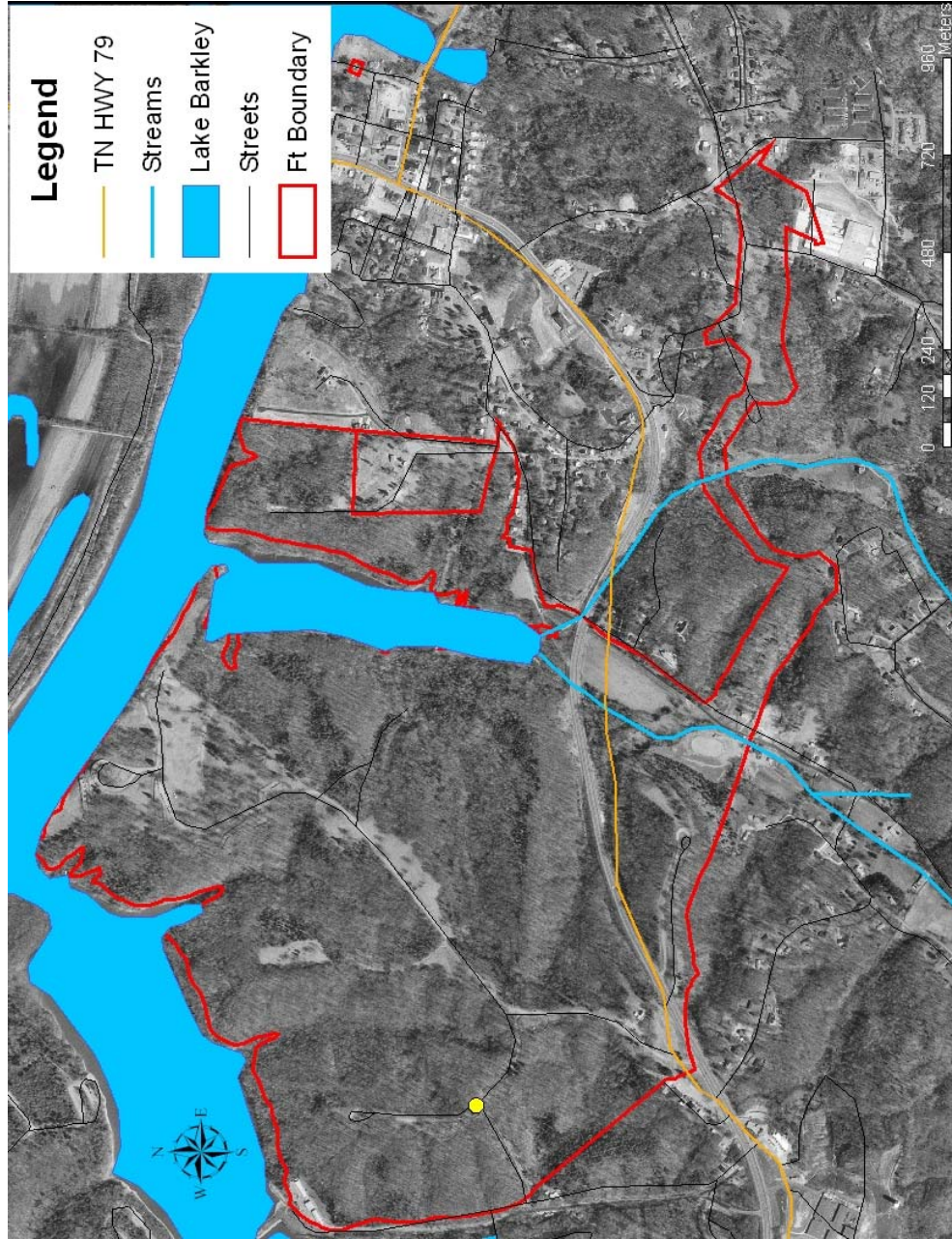


Figure A-20. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Notophthalmus viridescens* was documented, January 2004 through August 2005.

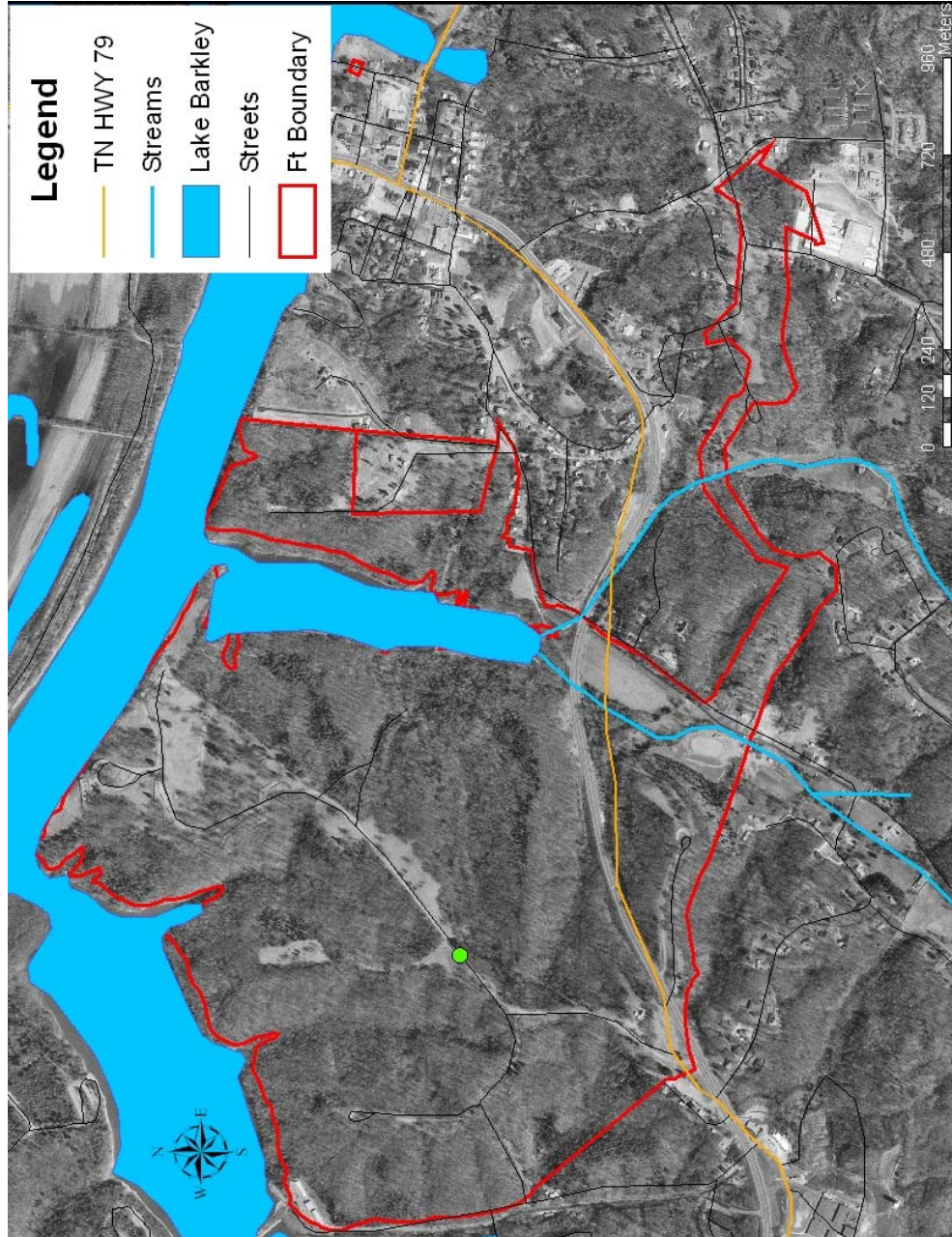


Figure A-21. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Opheodryx aestivus* was documented, January 2004 through August 2005.

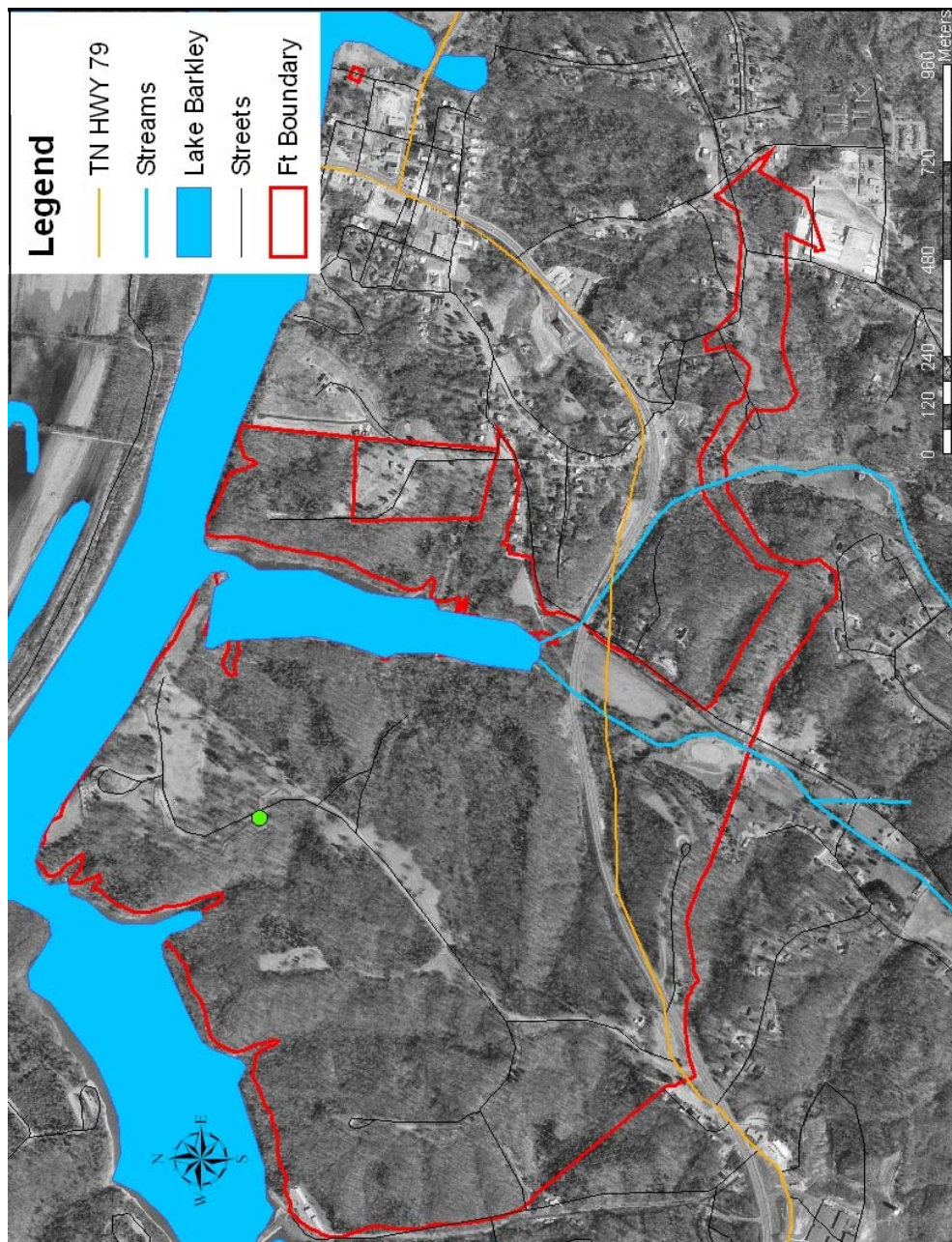


Figure A-22. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Pantherophis spiloides* was documented, January 2004 through August 2005.

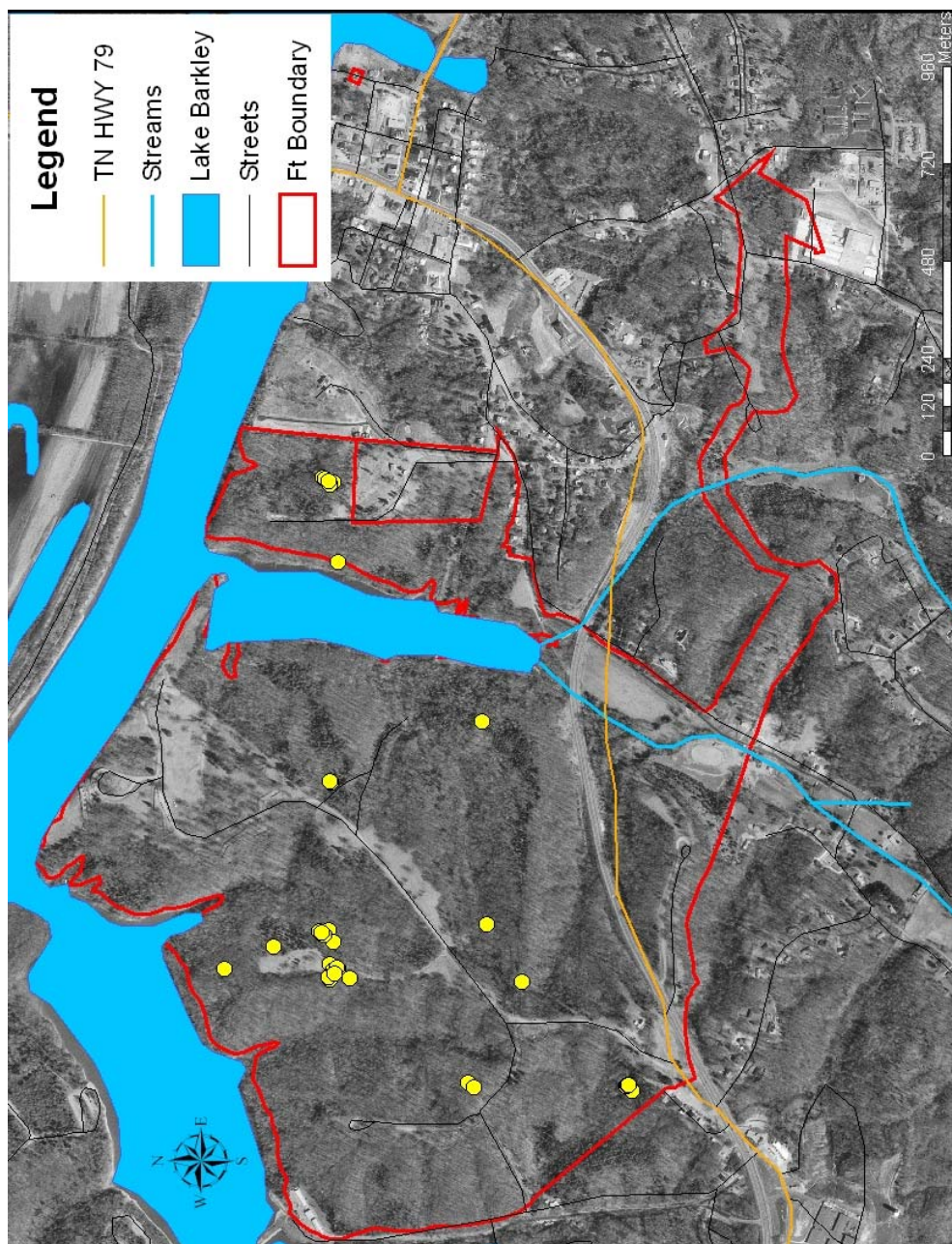


Figure A-23. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Plethodon dorsalis* was documented, January 2004 through August 2005.

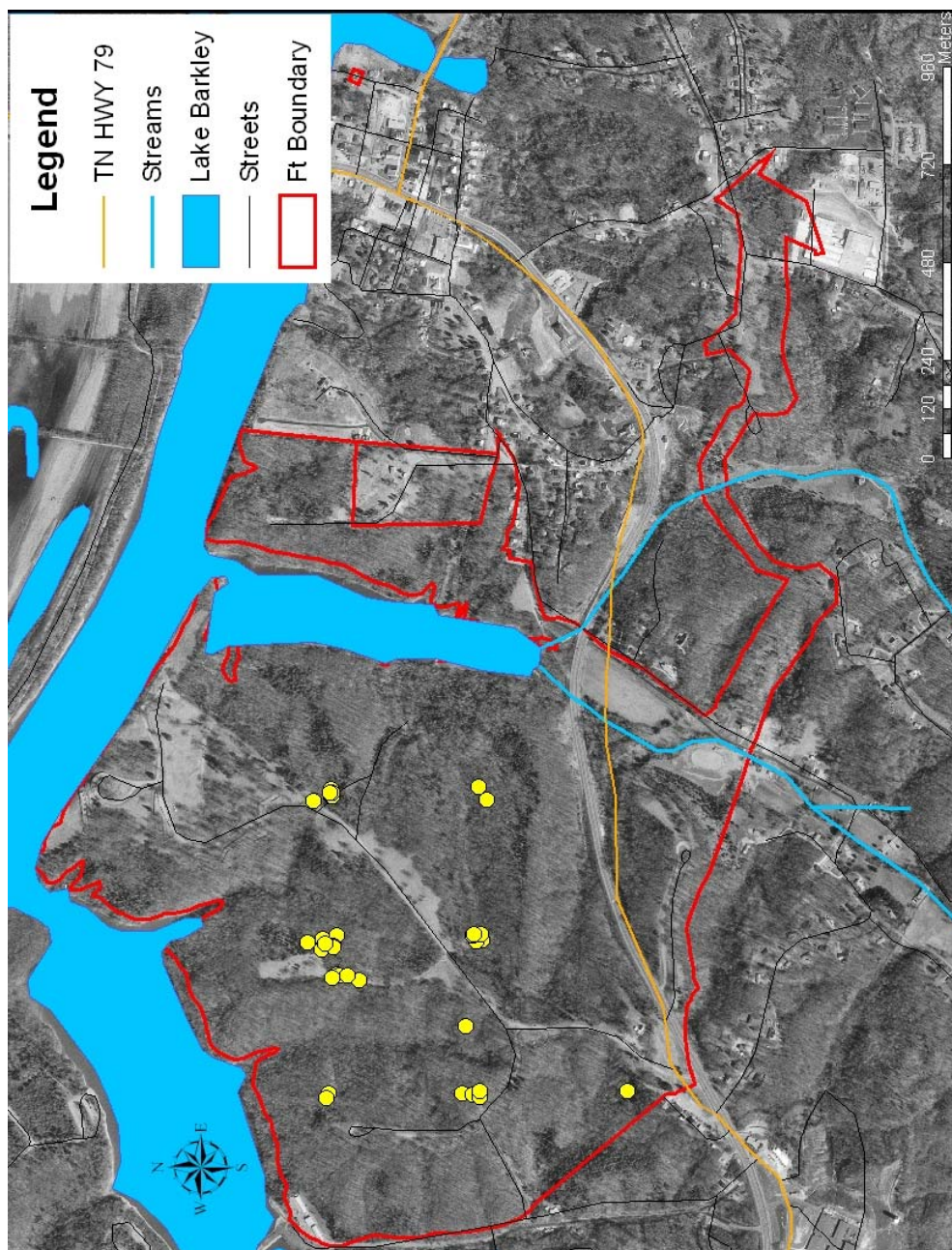


Figure A-24. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Plethodon glutinosus* was documented, January 2004 through August 2005.

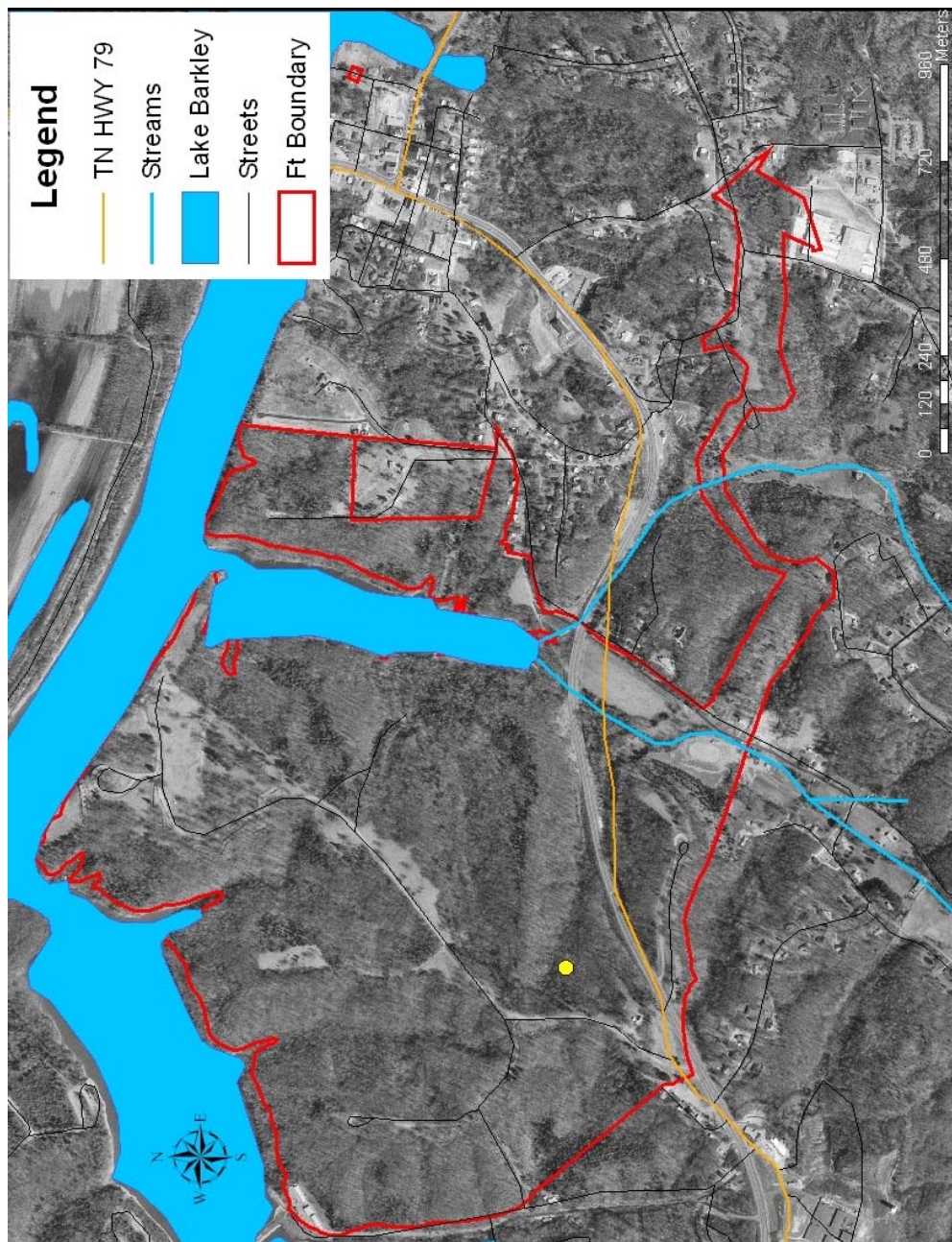


Figure A-25. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Pseudacris crucifer* was documented, January 2004 through August 2005.

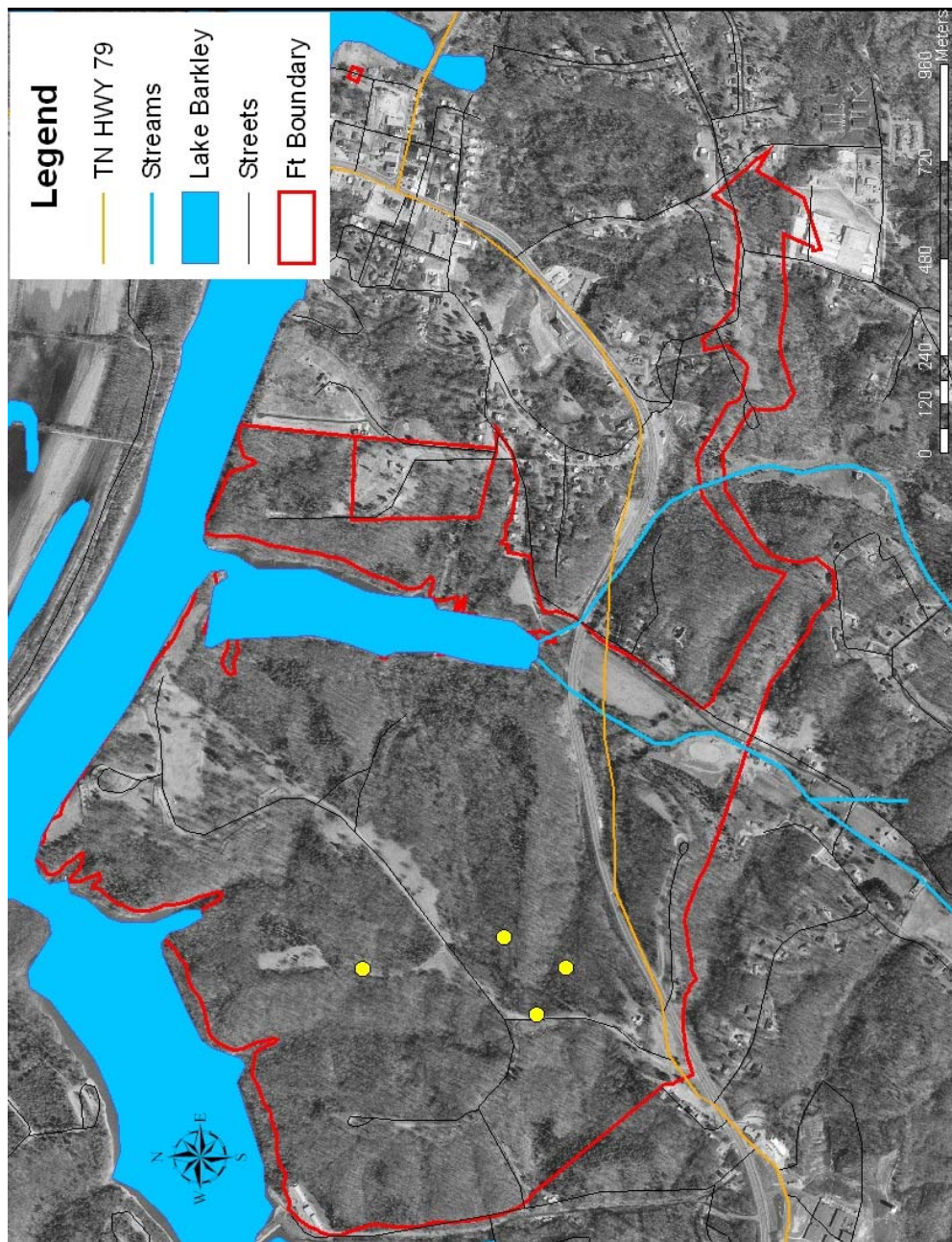


Figure A-26. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Pseudacris feriarum* was documented, January 2004 through August 2005.

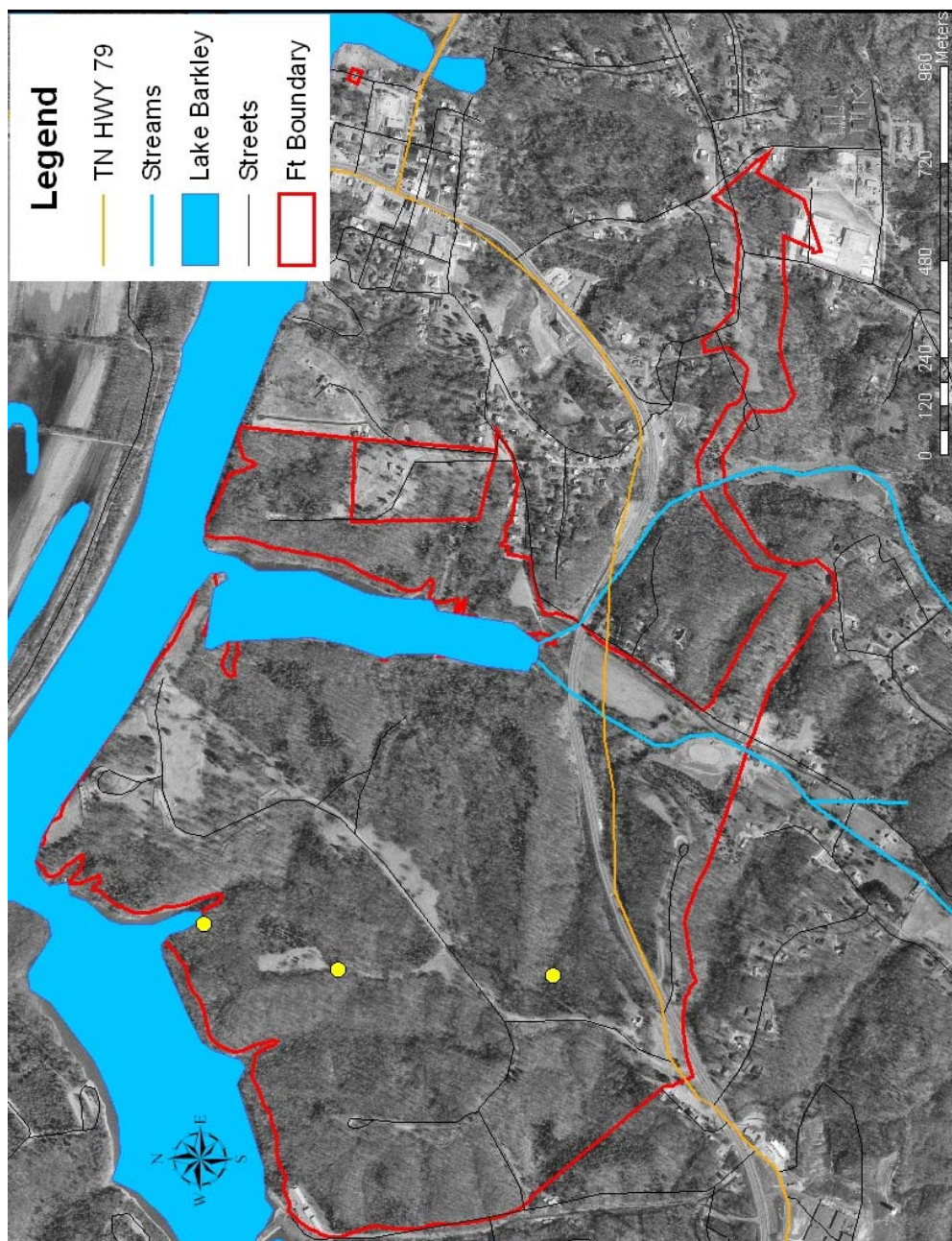


Figure A-27. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Rana catesbeiana* was documented, January 2004 through August 2005.

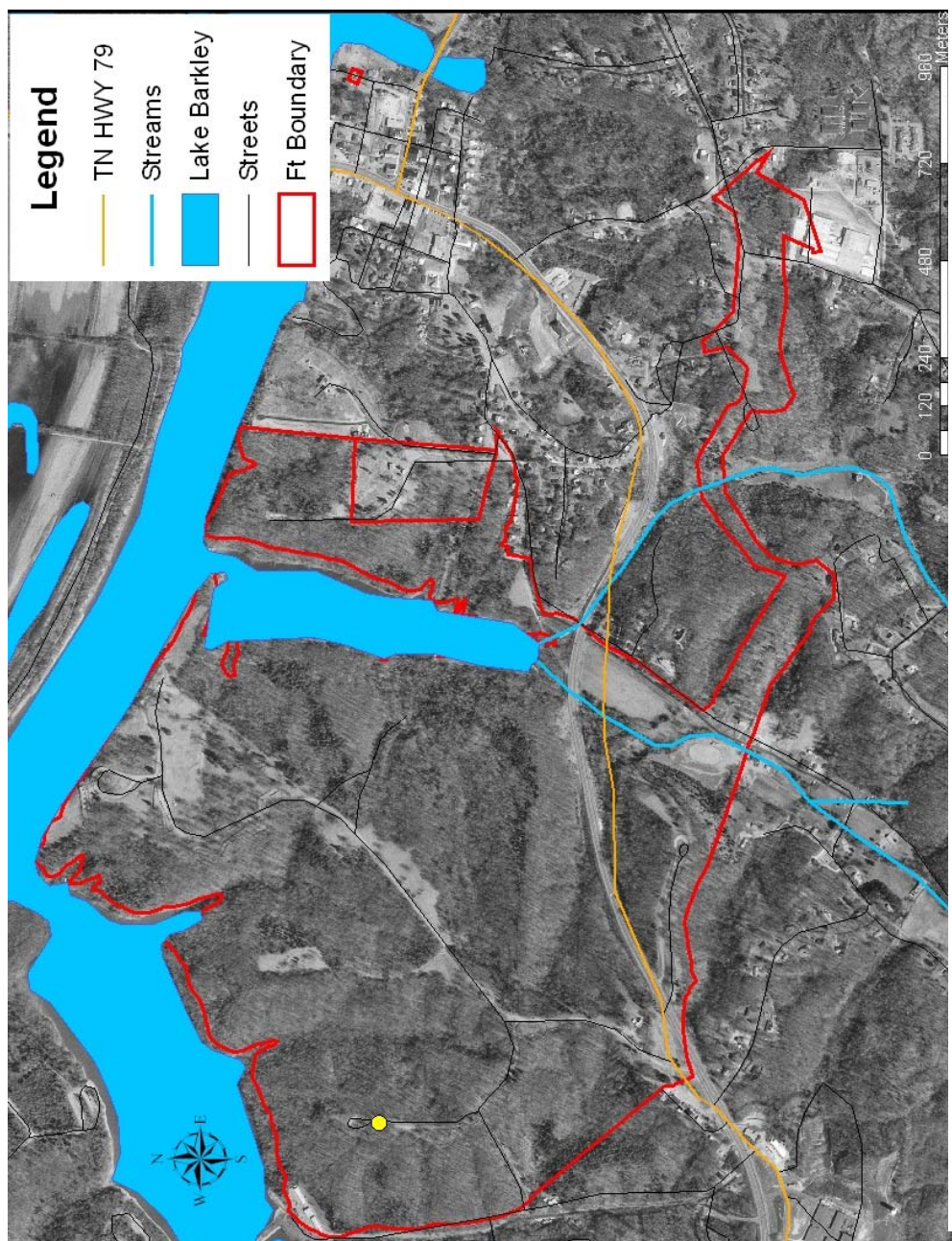


Figure A-28. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Rana clamitans* was documented, January 2004 through August 2005.

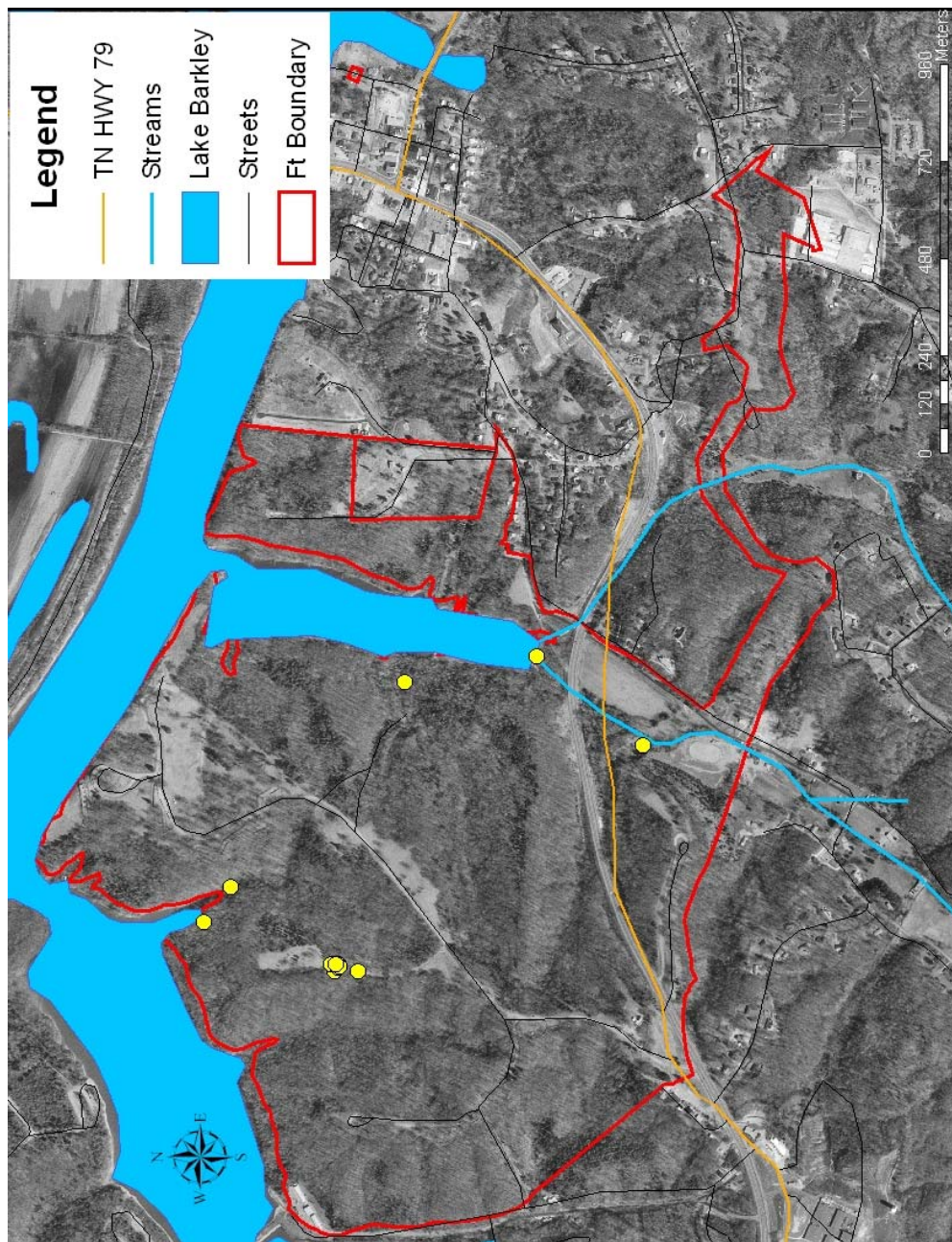


Figure A-29. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Rana sphenoccephala* was documented, January 2004 through August 2005.

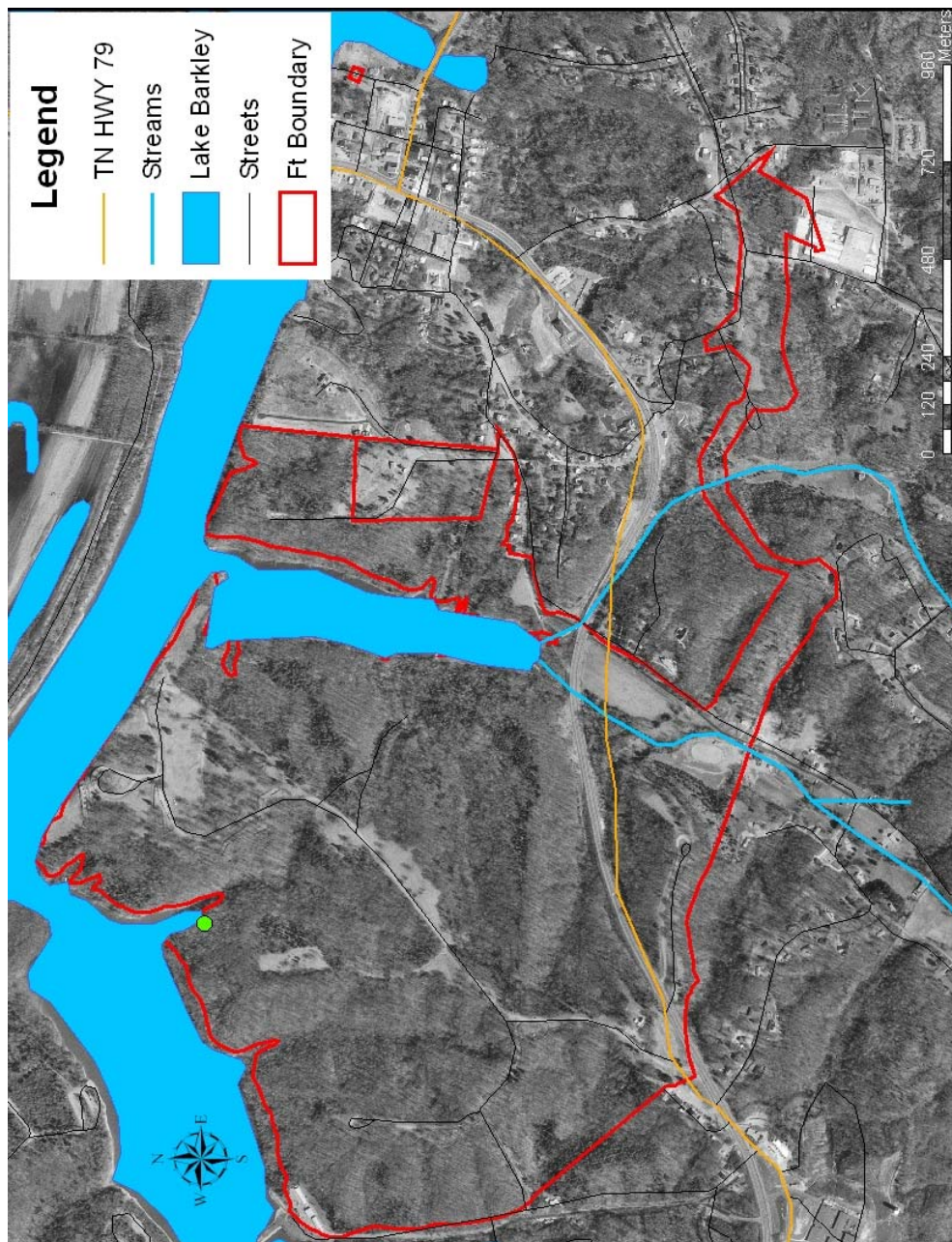


Figure A-30. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Regina septemvittata* was documented, January 2004 through August 2005.

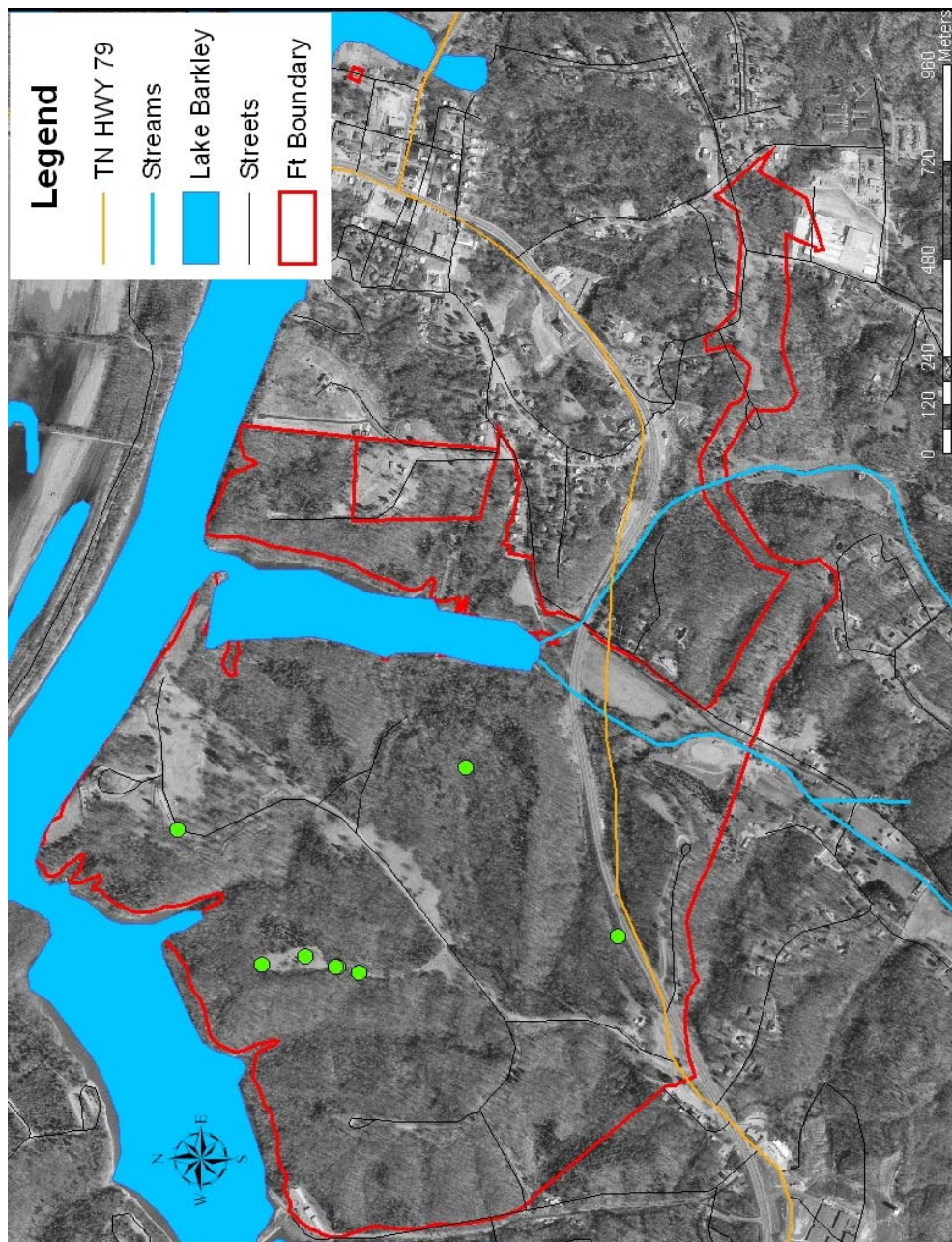


Figure A-31. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Sceloporus undulatus* was documented, January 2004 through August 2005.

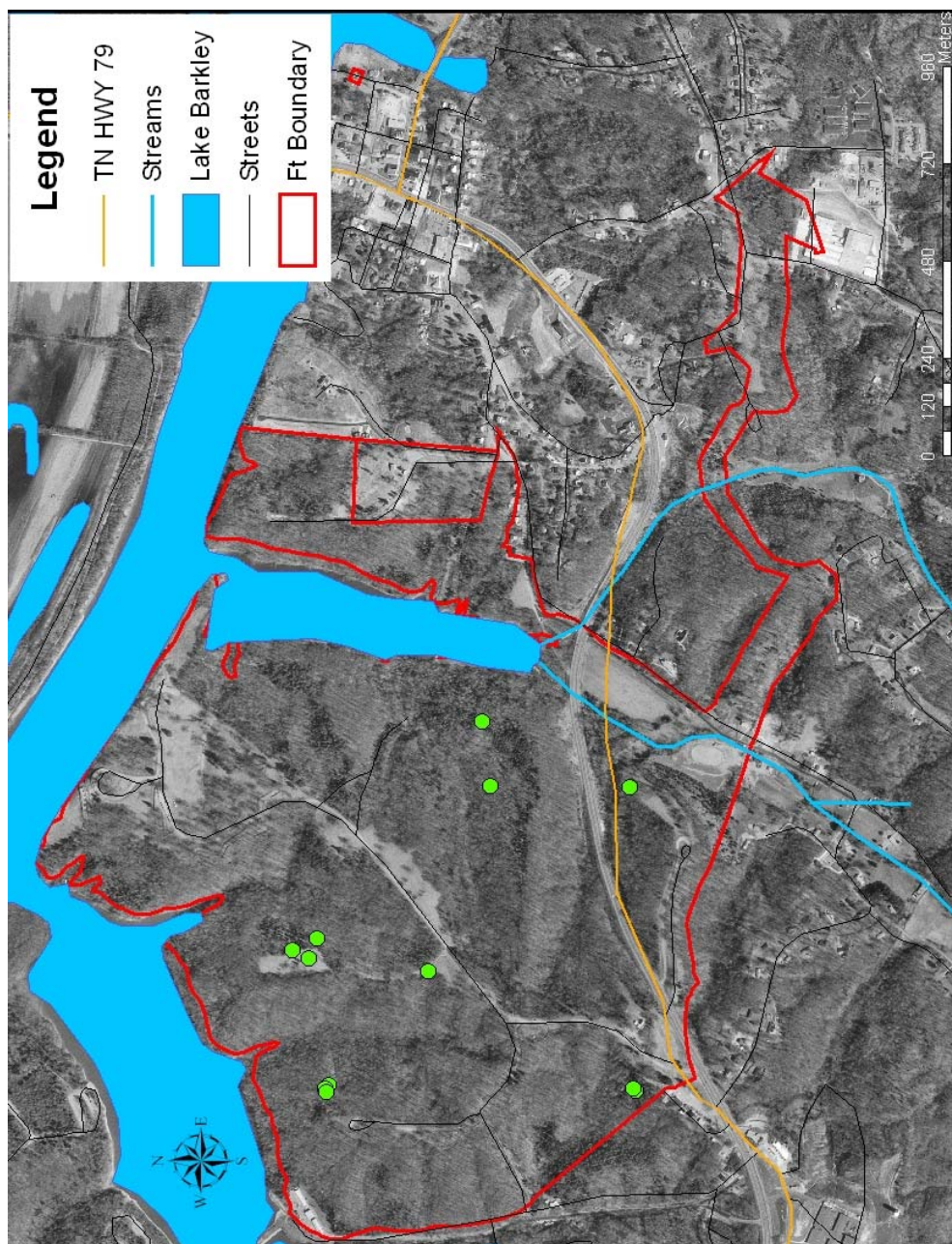


Figure A-32. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Scincella lateralis* was documented, January 2004 through August 2005.

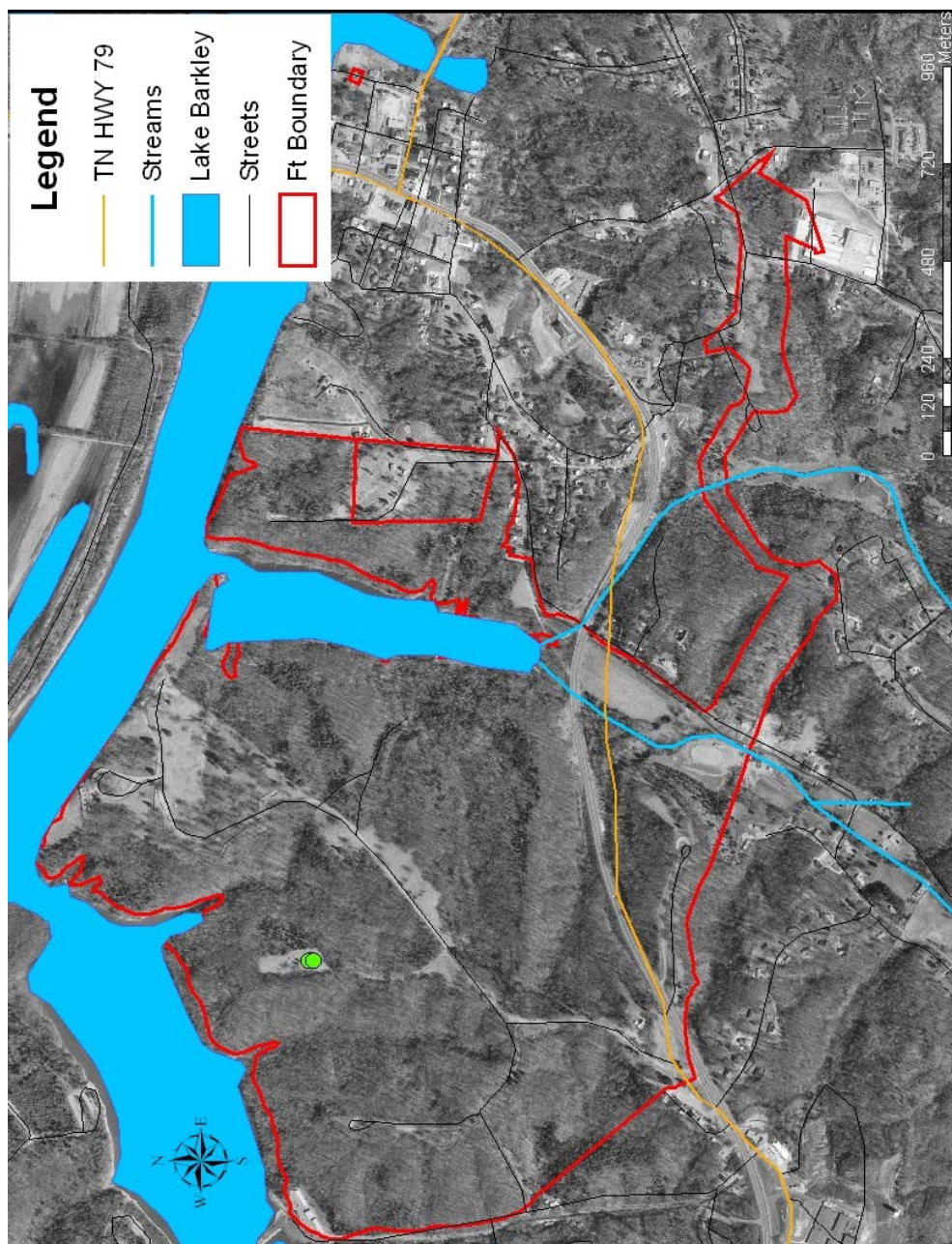


Figure A-33. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Storeria dekayi* was documented, January 2004 through August 2005.

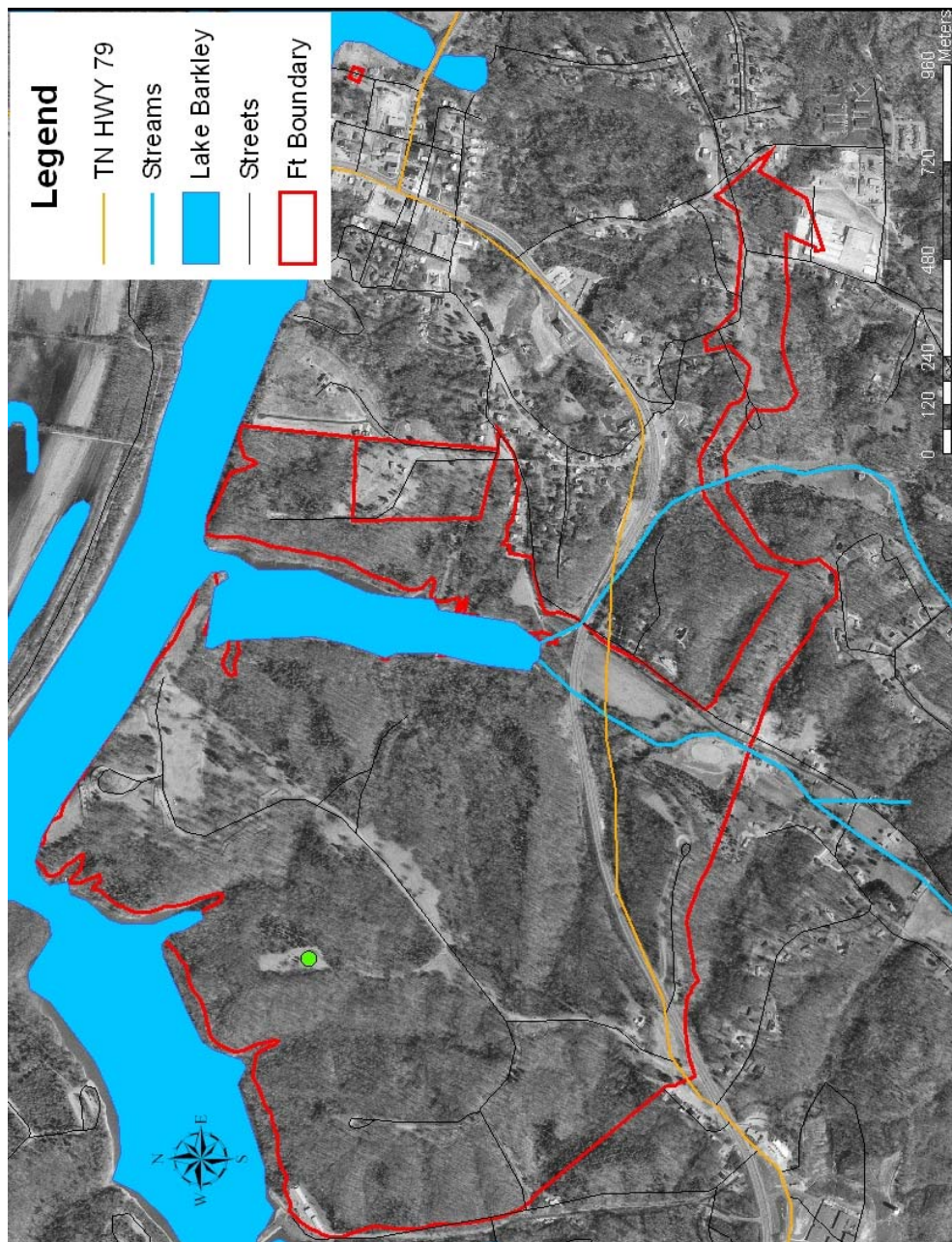


Figure A-34. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Storeria occipitomaculata* was documented, January 2004 through August 2005.

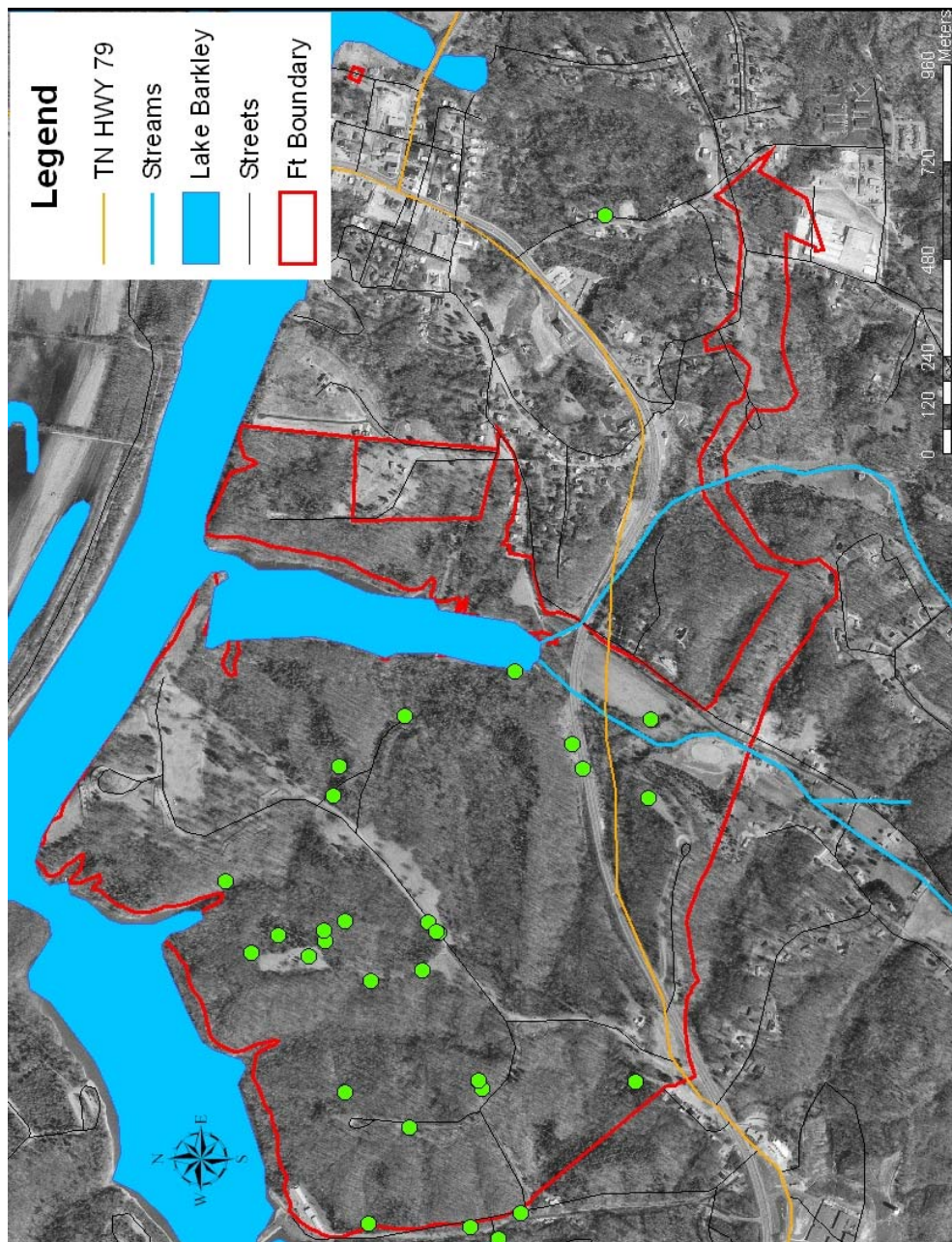


Figure A-35. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Terrapene carolina* was documented, January 2004 through August 2005.

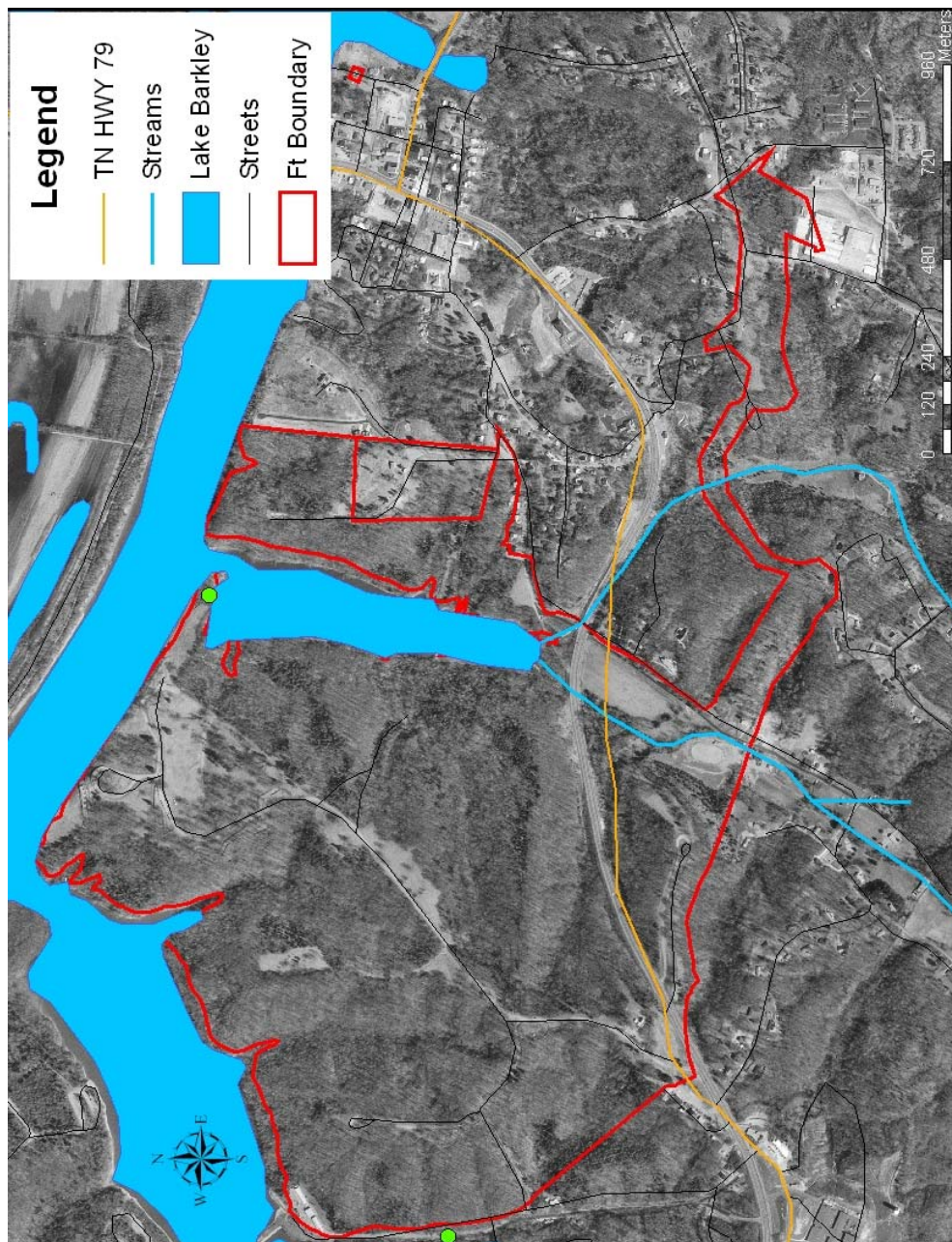


Figure A-36. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Thamnophis sirtalis* was documented, January 2004 through August 2005.

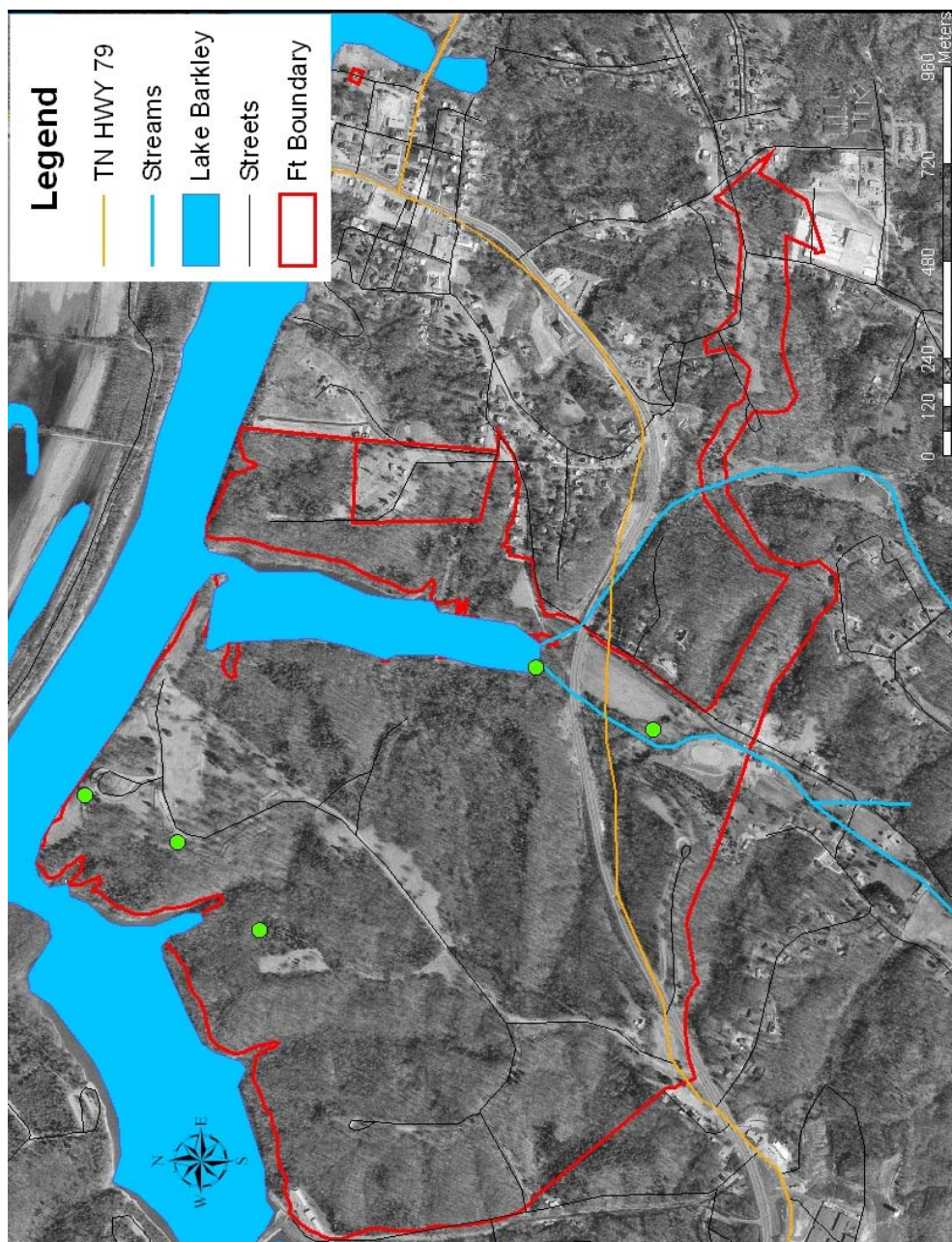


Figure A-37. Aerial photo showing locations (yellow dots) in Fort Donelson National Battlefield where *Trachemys scripta* was documented, January 2004 through August 2005.

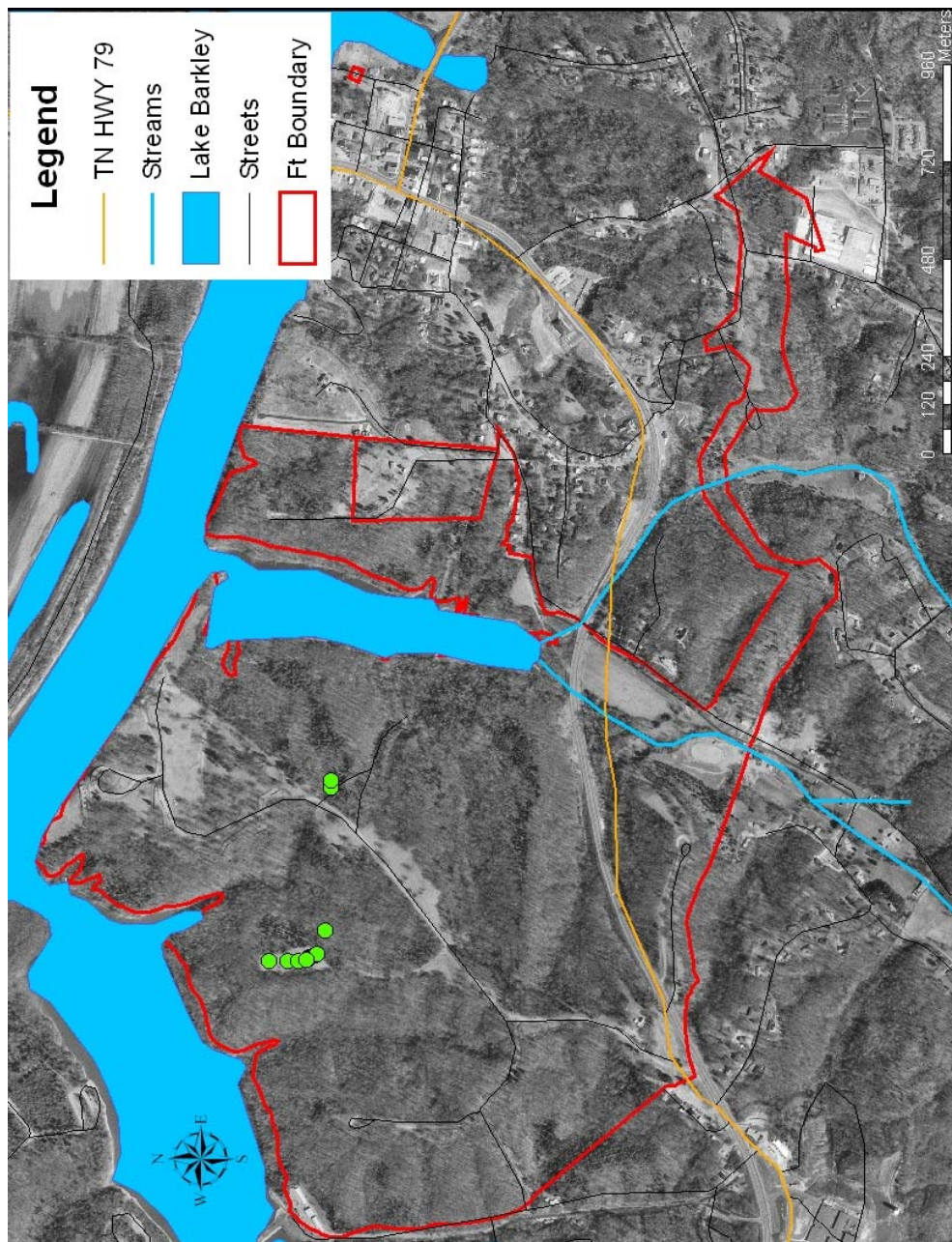


Figure A-38. Aerial photo showing locations (green dots) in Fort Donelson National Battlefield where *Virginia valerieae* was documented, January 2004 through August 2005.