

FINAL

Inventory of the Herpetofauna of Russell Cave National Monument



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**Cooperative Agreement
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**National Park Service
Cumberland Piedmont Inventory and Monitoring Network
PO Box 112
Mammoth Cave, KY 42259**

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INTRODUCTION

Russell Cave National Monument (RUCA) was established in 1961 when 125 ha were donated to the National Park Service (NPS) by the National Geographic Society. Russell Cave has one of the longest and most complete archeological records in the eastern United States. Artifacts indicate intermittent human habitation for almost 9,000 years. Varying styles of spears and arrow points show that different bands of Native Americans utilized the cave as a permanent home, as winter quarters, or, in the case of nomadic tribes, as a stopover.

Russell Cave National Monument is managed under the guidance of the 1916 Organic Act. The National Park Service is responsible for the preservation of native wildlife, including amphibian and reptile species, within Russell Cave National Monument in accordance with the 1916 NPS Organic Act, as amended and this direction is re-enforced through both NPS policy and guidelines affecting natural resource management. The Cumberland/Piedmont Inventory and Monitoring Network was established by the NPS Natural Resource Challenge Initiative. Among the goals set forth by this initiative are documentation of the occurrence of at least 90% of the species of vertebrates and vascular plants that occur within each National Park unit containing “significant natural resources” and documenting relative frequencies of occurrence by habitat type and descriptions of the distribution and relative abundance of species of special concern. Following a preliminary review of the existing inventory data within each network park, the Inventory and Monitoring Network for the Cumberland/Piedmont determined that the largest and most pressing data gaps involved amphibian and reptile species. This lack of information was targeted as one of the network’s highest priorities for funding. It is therefore necessary to conduct a baseline inventory of the herpetofauna resources within these NPS Parks, because the existing information is either non-existent or poorly defined.

This inventory effort will provide Park Managers with comprehensive, scientifically based information about the distribution and status of herpetofauna resources occurring within the parks. This information will be used for management decisions regarding park resources and protection, as well as education and outreach to the public. Further, this is an important part of the groundwork necessary for managers to develop effective monitoring programs designed to ensure the continued long-term health of Park natural resources.

Recent data shows that reptiles and amphibians are important, perhaps critical, components of terrestrial and aquatic ecosystems. Both groups are considered to be excellent indicator species of environmental degradation, amphibians because of their complex life cycle and permeable skin and reptiles because of their frequent position as the top carnivores in the food chain (Gibbons 1988). These facts have led to an increasing recognition of the need for collecting better data on the biodiversity and ecology of amphibians and reptiles by NPS managers (Scott and Seigel 1992).

Currently, NPS managers at Russell Cave National Monument possess neither a comprehensive baseline inventory nor the information upon which to base monitoring of the Park's amphibian and reptile species utilizing park lands and waters. In recent years, the shift to protecting biodiversity through the preservation of functional ecosystems has made reliable inventory and monitoring programs of critical importance to NPS management. Without detailed information on the distribution, habitat requirements and relative abundance of native amphibian and reptile species, resource managers may only preserve that portion of the fauna which is highly visible or economically important (Bogan, *et al*, 1988). For these reasons, Accipiter Biological Consultants was contracted by the NPS to design and develop a park-wide inventory of reptile and amphibian species currently occurring at the Park as part of the overall Inventory and Monitoring Program being conducted for the Cumberland/Piedmont Inventory and Monitoring Network.

GOALS AND OBJECTIVES

This inventory program for surveying reptile and amphibian species at Russell Cave National Monument has the following goals:

1. To determine species presence information, both habitat specific and across landscapes and to document at least 90% of the species thought to occupy the Park lands.
2. To document relative frequencies of occurrence by habitat type within the Park.
3. To describe the distribution and relative abundance of species of special concern within the Park.
4. To collect voucher specimens or photographs of species occurring in the Park which are not already documented. Emphasis is put on photographic vouchers in this park.

DESCRIPTION OF THE STUDY AREA

Russell Cave National Monument is 125 ha in size and contains the cave, a stream, sinkholes, and sandstone outcrops. The woods near the cave entrance are comprised of Blue Ash, Yellow Buckeye, White Basswood, and Tulip Poplar. The stream floodplain consists of Boxelder and Tulip Poplar. Wooded slopes contain a diverse canopy that includes Black Cherry, White Oak, Yellow Buckeye, American Beech, Black Locust, and hickory species. A small spring exists on the mountain above the cave near the location of where the mountain road enters private property.

Habitats and Descriptions

Nine major community types were utilized in this inventory process. These were provided by NPS personnel and include the following:

Mixed hardwood forest (MF) – This category consists of hardwood forest dominated by Beech and Maples. While it may occur under mesic conditions oak species do not dominate. It is usually found higher on the slopes than the following.

Mixed mesic hardwood forest (MH) – This habitat includes such tree species as Red and White Oaks, with smaller amounts of Beech, Basswood and Buckeye. It usually includes lower areas in the proximity of streams or springs.

Pine/Hardwood forest (PH) – This habitat consists of mixed Pine and hardwood species. It is usually found on slopes or ridges and usually has little understory. This habitat is usually drier than the previous habitat and is uncommon on the Park.

Oak/Hickory forest (OH) – This habitat is found on the wooded slopes, primarily along the Mountain Road. It is usually fairly dry with varying understory involved.

Open fields (OF) – This habitat consists of open, grassy areas and exists in several forms on the Park. Mowed fields and agricultural fields are also included in this habitat form.

Springs (SP) – Springs occur where ground water discharges to the surface. Small stream flows often result, however, for purposes of this inventory, only stream flows where the ground water discharge point is readily apparent are considered springs.

Streams (ST) – These habitats feature flowing water of an ephemeral, intermittent or perennial nature. Substrate on the bottom ranges from mud or sand to various sized cobbles or even bedrock. Streams are also often associated with adjacent habitats such as forests.

Ephemeral pools (EP) – This habitat consists of pools that exist only in response to precipitation and/or its subsequent runoff. They receive no water from springs and no long-continued supply from melting snow or other surface source. This habitat is usually associated with other habitat types such as surrounding forest or riparian corridors.

Wet rock faces (WR) – Rock faces which, either ephemerally or perennially have water running down them. The water may originate from a spring or from runoff. Various mosses and ferns are typical on these rock faces.

METHODOLOGIES

A detailed review of the field methods utilized in this inventory program is provided in the following paragraphs. This selection of methodologies was determined by the need to balance the availability of suitable personnel against the need to establish a valid, quantifiable inventory program.

This project began with a literature search to establish a potential list of reptile and amphibian species that include Russell Cave National Monument in their range of distribution. This search provided a potential list of 32 species or discernable subspecies. Further search was conducted to determine if potential habitat exists on Russell Cave National Monument for each species on that list and to gain insight on the life history of each species. A number of species reach the limit of their natural range at or near the Park. Confirming their presence was a priority during this inventory process.

We utilized 6 primary inventory methods to attain goals 1 and 2. These are random plots with associated sampling frameworks to provide standardized results for defined habitat areas and general herpetological collecting and observation, minnow traps, coverboards, audio frog breeding surveys, and drift fences utilizing funnel type live traps or cover boards to inventory special habitat areas. Road riding was considered as an inventory methodology, but was not utilized due to lack of roads within the Park. Only one box turtle was located on a road and since it was found adjacent to a general collecting site, it was attributed to that site under general collecting.

Random Plots with Associated Sampling Frameworks

Circular, 1-hectare random plots were established by the NPS as part of the networks' vegetation mapping/plant inventory project. Most of the plots fall within common habitats that comprise much of the area within the park – primarily terrestrial or rarely flooded environments. These include both open and wooded habitats. Operationally, the grid plots are sampled in a structured manner that involves cover boards and constrained-area searches within the 8 m² rectangular plots, as well as generalized searches of the remainder of the circular 1-hectare plot. The structured placement of the cover boards and 8m² rectangular plots for constrained-area searches is for the purpose of producing standardized results for defined habitat areas that can be compared to estimate relative species richness among parks and habitat types. Within plots, one of two survey techniques were applied uniformly across all spatial and temporal replicates, unless otherwise provided for. (a) Where the plots fell either in open environments or in floodplains (whether open or forested) cover boards were used, as shown in Statement of Work. (b) Where the plots fell in upland forest and woodland, 8m² plots without cover boards were used in a system of “area-constrained searches”.

- a. Cover board methodology: Applicable in open environments such as prairies, old fields and hay fields, as well as flood plains and riparian corridors, and in forest/field edges.
 - i. Within each 1-ha plot, four cover boards were laid out in a systematic cluster, as shown in the Statement of Work.
 - ii. Two boards were placed flush with a line running north through each plot center. The northwest corner of one of these boards was placed flush with the east side of the line at 10 meters north of the center point. The southeast corner of the other board was placed flush with the west side of the line at 10 meters south of the center point.
 - iii. Two boards were placed flush with a second line that runs perpendicular to the north running line (90°- 270°). The northeast corner of one of these boards was placed flush with the south side of the line at 10 meters east of the plot center. The southwest corner of the other board was placed flush with the north side of the line at 10 meters west of the center point.
 - iv. At each plot, 2 of the boards were wooden and the other 2 were tin (of approximately equivalent dimensions). Preferred material for the wooden boards was 4' X 4' plywood.

b. Area constrained search (ACS) methodology: To be applied in wooded environments such as upland and successional forest (where cover boards are not used).

- i. At each 1 ha plot, four ACS plots were laid out in a systematic cluster as illustrated in the Statement of Work.
- ii. Each ACS plot was 8m².
- iii. Two ACS plots were placed flush with a line running north through each grid point. The northwest corner of one of these plots was placed flush with the east side of the line at 20 meters north of the plot center. The southeast corner of the other plot was placed flush with the west side of the line at 20 meters south of the center point.
- iv. Two ACS plots were placed flush with a second line that runs perpendicular to the north running line (90°- 270°). The northeast corner of one of these plots was placed flush with the south side of the line at 20 meters east of the plot center. The southwest corner of the other plot was placed flush with the north side of the line at 20 meters west of the center point.

Frequency of cover board and ACS sampling on sample plots: Within each 1 ha plot, each set of cover boards and/or set of ACS plots were sampled at least once during each season in which herpetofauna are active.

During the course of this inventory 12 of these plots were utilized and have been surveyed six times. Results of these surveys may be found in Appendix A. Table 1 lists the utilized plots and their location and affiliated habitat.

Table 1: Random Plots Established by Nature Serve

Plot #	UTM Coordinates NAD 83	Habitat
RUCA 1	16 S 607629 3870162	OH
RUCA 2	16 S 607646 3870466	PH
RUCA 3	16 S 607640 3870755	PH
RUCA 4	16 S 607927 3870162	OH
RUCA 5	16 S 607939 3870468	MH
RUCA 6	16 S 607934 3870774	OH
RUCA 7	16 S 607971 3871068	MH
RUCA 8	16 S 608229 3871051	MH
RUCA 9	16 S 608330 3871313	MH
RUCA 10	16 S 608557 3871055	MF
RUCA 11	16 S 608547 3871362	MH
RUCA 12	16 S 608715 3871121	MH

General Herpetological Collecting and Observation

Also known as hand collecting, this method is purported to provide the largest number of individuals and species based on comparable inventory projects. Specific methods included

carefully turning and replacing ground cover, time constrained hand collecting, seining and dip netting of small ponds or streams within the area, and spotlight surveys of aquatic habitats. Some hand collecting was accomplished by raking small areas of forest floor debris on appropriate plots. All disturbed habitats were restored to their original condition to the greatest degree possible. This methodology also includes visual observations of reptiles and amphibians made during the survey of the area, including surveys of basking turtles, frogs and snakes at a distance utilizing binoculars. Sites have been chosen so as to sample each major habitat within the Park unit. During the course of this inventory 5 sites have been established to sample the major as well as specialized habitats within the Park. Each has been sampled six times. Data on reptiles and amphibians located during this sampling is located in Appendix A. Table 2 lists the utilized plots and their location and affiliated habitat.

Table 2: General Collecting Sites

Plot #	UTM Coordinates NAD 83	Habitat
G-1	16 S 608215 3871139	MH
G-2	16 S 607896 3870084	SP
G-3	16 S 608650 3871489	OF, PH
G-4	16 S 608426 3871556	SP, MH, WR
G-5	16 S 608646 3871167	ST, EP,WR

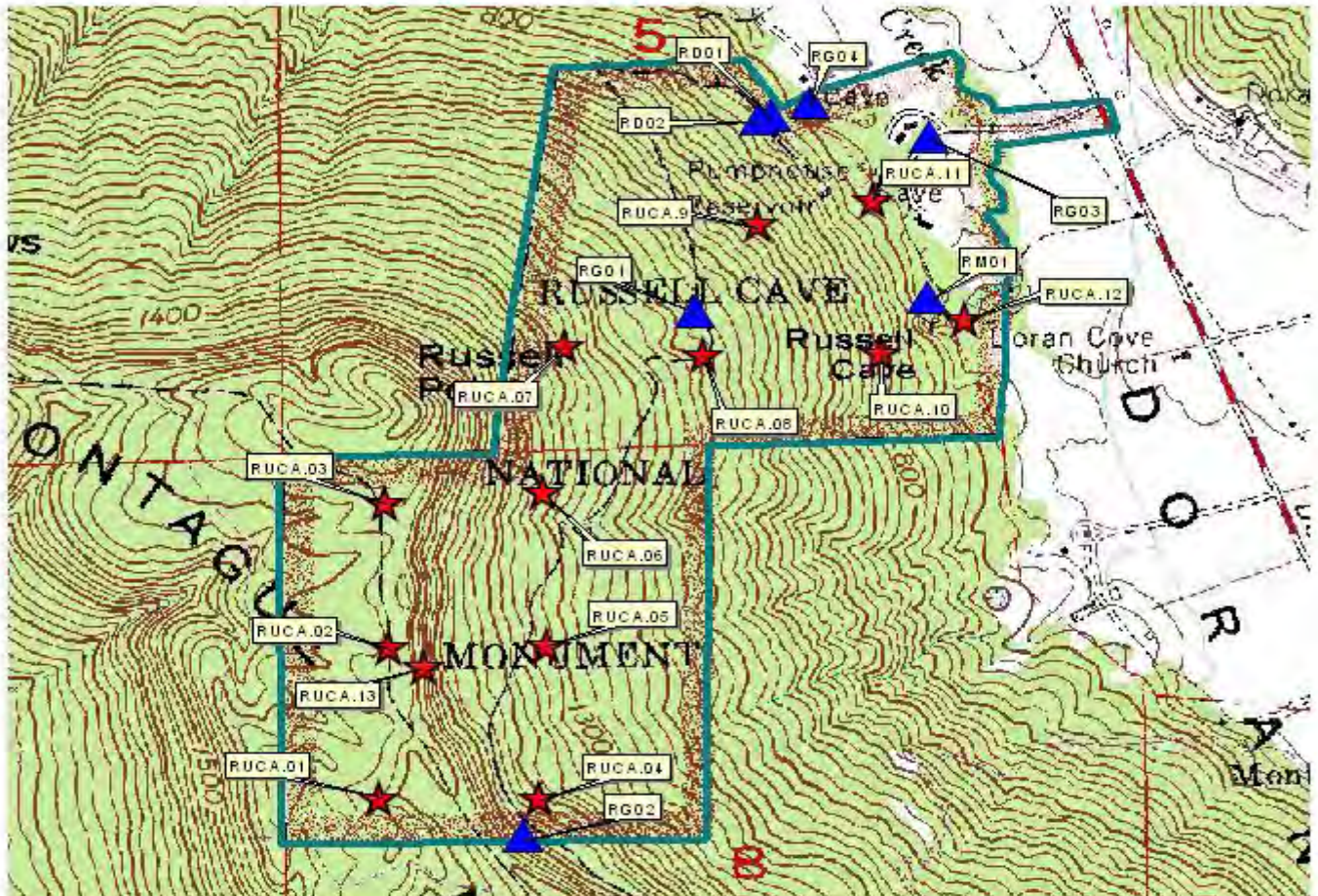
Minnow Traps

Minnow traps are an effective means of capturing aquatic amphibians and reptiles, especially tadpoles, frogs, salamanders, salamander larvae and aquatic snakes. They can be set in most aquatic situations, but appear to be most effective in ponds or swamps with shallow waters. Traps are set near the shoreline, in water deep enough to at least cover the funnel openings. The traps are set from 5-10 meters apart and are checked daily. During the course of this inventory 2 sites have been identified for utilization of this methodology. Some of these suffered from lack of water depth during the late summer visits. The other was sampled during those timeframes. Data on reptiles and amphibians located during these samplings is located in Appendix A. Table 3 lists the utilized plots and their location and affiliated habitat.

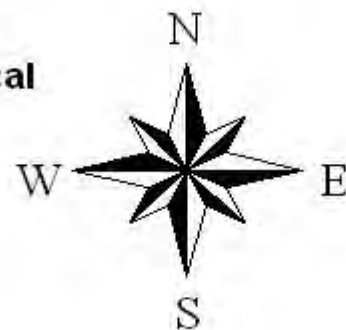
Table 3: Minnow Trapping Sites

Plot #	UTM Coordinates NAD 83	Habitat
M-1	16 S 608646 3871167	EP
M-2	16 S 608426 3871556	ST

Russell Cave Sampling Plot Locations



- ▲ Plots established by Accipiter Biological
- ★ NatureServe plots



Coverboards (Artificial Shelters)

One of the major disadvantages of minnow and other “active” traps is that they must be set and monitored on a continual basis. An alternative method of inventorying herpetological communities involves the use of artificial shelters established in systematic arrays in various habitats. This method has been utilized extensively to sample reptile and amphibian populations nationwide in a variety of habitats. The major advantages of this approach are that they require no maintenance and they can be checked whenever time permits. These shelters are very effective in sampling salamanders, lizards, snakes and frogs. The sampling scheme utilized consists of the following; Arrays of coverboards consisting of .66 meter by .66 meter sections of exterior plywood were established and set up. Each array consisted of at least four boards and was arranged randomly through each terrestrial habitat block located on Park. All were sampled every field day during the study that investigators are in the area of the array. Realistically, arrays should be sampled at least a month after they are set up to allow the boards to age and to adequately compact the vegetation under them for easier visibility of reptiles and amphibians utilizing the shelters. These coverboards were also utilized in conjunction with drift fences because pitfall traps cannot be used due to the ground disturbing nature in an historical park. (See Drift Fences section below.)

Frog Breeding Surveys

The fact that anuran amphibians congregate for breeding allows for highly effective inventories of these species. These surveys involve the systematic survey of major aquatic habitats during the primary breeding seasons for these species in early spring and early summer.

Sites established under this approach were surveyed by spot lighting at night and by active listening in the various aquatic habitats by the biologists involved in this study. During the course of this inventory, the entire Park was driven twelve times at speeds appropriate for the road riding methodology detailed below, six times during the day and six times at night (after dark). At least 7 sites were established to have calling anurans during those surveys. Those sites were specifically monitored throughout the remainder of this inventory process. Data on frogs and toads located during this sampling is located in Appendix A. Table 4 lists the utilized plots and their location and affiliated habitat.

Table 4: Frog Breeding Survey Sites

Plot #	UTM Coordinates NAD 83	Habitat
G-1	16 S 608215 3871139	MH
G-2	16 S 607896 3870084	SP
G-3	16 S 608650 3871489	PH
G-4	16 S 608426 3871556	ST
G-5	16 S 608646 3871167	EP
M-1	16 S 608646 3871167	ST
R-12	16 S 608715 3871121	MH

Drift Fences

Drift fences are frequently a most productive method of inventorying herpetological communities. Equipped with pitfall traps, funnel traps or both, studies show that the productivity of drift fences is significantly higher than hand-captures, although, this does not always apply in all areas of the country. These arrays were set up to sample each terrestrial habitat identified on the Park lands. These arrays have been developed using 10 inch aluminum flashing for drift fence material with plastic 5-gallon pails embedded in the ground so that the top was flush with the ground surface being used for pitfalls. Aluminum screen funnel traps and plastic funnel traps used by commercial snake breeders were used to augment the trapping effort at the drift fence sites. This methodology was further augmented by the use of .66 meter by .66 meter coverboards placed alongside the drift fences since pitfall traps could not be utilized due to the ground disturbing nature in an historical park. Two sites were established utilizing these sample methods on the Park with the first active trapping beginning during the spring 2004 surveys with data on reptiles and amphibians located during the sampling located in Appendix A. Table 5 lists the utilized plots and their location and affiliated habitat.

Table 5: Drift Fence Sites

Plot #	UTM Coordinates NAD 83	Habitat
D-1	16 S 608354 3871533	MF
D-2	16 S 608332 3871524	MF

ANALYSIS OF SURVEY METHODOLOGY EFFICIENCY

Table 6 summarizes the overall efficiency of the five field methodologies utilized in this survey as well as the efficiency of all five combined. An efficiency quotient has been established to enumerate this efficiency and is determined by dividing the number of species inventoried by a certain methodology by 32, the total number of species known to occur in the general area of Russell Cave National Monument. This would give a numerical value of the likelihood of a given methodology to accomplish a total inventory given the conditions available on Russell Cave National Monument during the survey.

Table 6: Field Methodology Efficiency Analysis

Methodology	No. of Species (n)	No. of Individuals	Efficiency Quotient (n/32)
General Herpetological Collecting	21	595	.656
Minnow Traps	5	201	.156
Random Plots	4	11	.125
Frog Breeding Surveys	8	35+	.250
Drift Fences	4	6	.125

Combined Five Methodologies	29	848+	.906
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Table 6 shows very low efficiency quotients for several of the methodologies used in this inventory. This is to be expected as minnow traps and frog breeding surveys target smaller numbers of species than other methodologies. Each methodology has its own strengths and weaknesses as an inventory device. These and other potential biases will be discussed in the following paragraphs. Weather is a factor affecting the efficiency of all individual field methods, as well as the combination of the five.

PROCESSING OF INDIVIDUALS

All reptiles and amphibians captured or observed to date have been identified to species (many to identifiable subspecies), and where possible, sexed, measured for length (snout to vent length is becoming the standard for measuring snakes, lizards and amphibians, while carapace length is used for turtles), weighed and checked for reproductive condition. All lengths are recorded in millimeters while weights are recorded in grams. Sexing of snakes is done by probing which has a 96% reliability rate. Lizards are sometimes harder to sex, but anal pores and display markings of males are helpful in this respect. Turtles are sexed by a combination of indented plastron of most male individuals and location of the vent in relation to the end of the shell. Frogs, toads and salamanders are hard to sex with any degree of reliability outside the breeding season.

RESULTS

Analysis of Species Richness and Relative Abundance

The following tables and text analyze the species richness and relative abundance of the reptiles and amphibians found on Russell Cave National Monument in two contexts; parkwide and at the habitat level. The numbers in the tables reflect the relative abundance of that species compared to other species within that assemblage. This number is acquired by dividing the number of individuals found by the number of sampling points located within that geographic area or habitat (Jones, 1988). These numbers reflect only the results of this inventory and do not include previous or concurrent studies on the Park.

Table 7: Species Richness Analysis

<u>Level of Analysis</u>	<u>Number of Species</u>
Parkwide	29
Habitats	
Mixed Hardwood Forest	6
Mixed Mesic Hardwoods	14
Oak/Hickory Forest	3
Pine/Hardwood Forest	3

<u>Level of Analysis</u>	<u>Number of Species</u>
Open Field	6
Ephemeral Pond	4
Spring	5
Stream	11
Wet Rock Face	2

Table 8: Relative Abundance at Park Level

Species	Relative Abundance Factor
Zigzag Salamander	.212
Northern Slimy Salamander	.424
Tennessee Cave Salamander	.030
Southern Two-lined Salamander	.060
Longtail Salamander	.030
Cave Salamander	.090
American Toad	.848
Fowler's Toad	16.697
Barking Treefrog	.090
Cope's Gray Treefrog	.212
Spring Peeper	.121
Upland Chorus Frog	.121
Eastern Narrowmouth Toad	.030
Green Frog	4.242
Southern Leopard Frog	1.181
Pickerel Frog	.060
Eastern Box Turtle	.121
Eastern Fence Lizard	.273
Ground Skink	.030
Five-lined Skink	.242
Midland Watersnake	.030
Eastern Garter Snake	.121
Smooth Earth Snake	.030
Ringneck Snake	.242
Eastern Worm Snake	.030
Rat Snake	.030
Black Kingsnake	.030
Copperhead	.030
Timber Rattlesnake	.030

Table 9: Relative Abundance by Terrestrial Habitats

Species	Mixed Hardwood Forest (3 Sites)	Mixed Mesic Hardwoods (10 Sites)	Oak/Hickory Forest (3 Sites)	Pine/Hardwood Forest (4 Sites)	Open Field (1 Site)
Zigzag Salamander		.100			
Northern Slimy Salamander	.333	.700	.667	.750	
Tennessee Cave Salamander					
Southern Two-lined Salamander					
Longtail Salamander	.333				
Cave Salamander	.333				
American Toad		.300			
Fowler's Toad					1.000
Barking Treefrog		.200			
Cope's Gray Treefrog		.100		.500	
Spring Peeper		.400			
Upland Chorus Frog					
Eastern Narrowmouth Toad					
Green Frog		.700			
Southern Leopard Frog					
Pickerel Frog					
Eastern Box Turtle		.100			3.000
Eastern Fence Lizard					9.000
Ground Skink					1.000
Five-lined Skink	.333	.100			6.000
Midland Watersnake					
Eastern Garter Snake		.200	.333		1.000
Smooth Earth Snake			.333		
Ringneck Snake	1.667	.300			
Eastern Worm Snake	.333				
Rat Snake		.100			
Black Kingsnake				.250	
Copperhead		.100			
Timber Rattlesnake		.100			

Table 10: Relative Abundance by Aquatic Habitats

Species	Stream (4 Sites)	Spring (3 Sites)	Ephemeral Pond (3 Sites)	Wet Rock Face (2 Sites)
Zigzag Salamander		2.000		
Northern Slimy Salamander	.250			
Tennessee Cave Salamander	.250			
Southern Two-lined Salamander				1.000
Longtail Salamander				
Cave Salamander	.250			.500
American Toad			8.333	
Fowler's Toad	.750	1.000	181.333	
Barking Treefrog	.250			
Cope's Gray Treefrog	1.000			
Spring Peeper				
Upland Chorus Frog		1.333		
Eastern Narrowmouth Toad	.250			
Green Frog	1.500	.333	42.000	
Southern Leopard Frog	3.500	4.000	4.333	
Pickerel Frog	.500			
Eastern Box Turtle				
Eastern Fence Lizard				
Ground Skink				
Five-lined Skink				
Midland Watersnake	.250			
Eastern Garter Snake				
Smooth Earth Snake				
Ringneck Snake				
Eastern Worm Snake				
Rat Snake				
Black Kingsnake				
Copperhead				
Timber Rattlesnake				

THREATENED AND ENDANGERED SPECIES

Russell Cave National Monument is located in Jackson County, Alabama. The federal Endangered Species Act (ESA) lists a number of species as endangered, threatened or as candidate species for listing under those designations.

The Endangered Species Act lists the following species occurring in Alabama as **endangered**:

Mississippi Gopher Frog	Leatherback Sea Turtle
Atlantic Hawksbill Turtle	Alabama Redbelly Turtle
Kemp's Ridley Sea Turtle	

None of these species naturally occur near Russell Cave National Monument and none were found during this inventory.

The Endangered Species Act lists the following species occurring in Alabama as **threatened**:

Flatwoods Salamander	Green Sea Turtle
Red Hills Salamander	Flattened Musk Turtle
Eastern Indigo Snake	Gopher Tortoise
Loggerhead Sea Turtle	

None of these species naturally occur near Russell Cave National Monument and none were found during this inventory.

The Endangered Species Act lists the following species occurring in Alabama as **candidate** species for listing. By law, these species must be treated as though they were listed until a final determination is made.

Black Warrior Waterdog	Black Pine Snake
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Neither of these species naturally occurs near Russell Cave National Monument and none were found during this inventory.

The State of Alabama lists the following species as **protected species**. Species with a state protected status are protected by the Nongame Species Regulation (Section 220-2-.92, page 79-82) of the *Alabama Regulations for 2005-2006 on Game, Fish, and Fur Bearing Animals*. In addition to the following species, all Alabama species listed above under the Endangered Species Act are protected under this state statute.

Pine Barrens Treefrog	Alligator snapping Turtle
Gopher Frog	Barbour's Map Turtle
Hellbender	Escambia Map Turtle
Green Salamander	Delta Map Turtle
Seal Salamander	Black-knobbed Sawback
Southern Hognose Snake	Alabama Map Turtle
Coachwhip	Mississippi Diamondback Terrapin
Gulf Salt Marsh Snake	Florida Softshell (Partial protection by size limit)
Florida Pine Snake	

Of these species only the Green Salamander, Hellbender and Seal Salamander have distributions that include the area of Russell Cave National Monument. Habitat for the Hellbender does not occur in Russell Cave National Monument. Potential habitat exists for the Seal Salamander in

the streams flowing into the cave mouth and in the Ridley Cave area of the Park, although these stream segments are disjunct from other populations of this species. Potential habitat for the Green Salamander exists along the walls of both caves where moisture exists near the streams. No individuals of any of these species were located during this inventory process although a determined effort was made specifically to locate the discussed three species. However, park employees located and photographed an adult and a juvenile Green Salamander on the park after the fieldwork was completed.

DISCUSSION

During the course of this inventory process several potential sources of bias were noted. Weather nearly always creates some bias in herpetological survey. Because of the need for fairly exacting moisture and heat parameters by most reptile and amphibian species, some bias is certain to occur. During the time of our surveys, weather appeared to be within normal parameters for the area of the Park. Therefore, little bias would enter in to these survey results.

Another thing that became apparent was that randomly placed plots do not work well for reptiles and amphibians. They do work for birds, but, for more sedentary species, they do not seem to be of much value. Most reptiles and amphibians depend on fairly exacting microhabitats in which to live and randomly placed plots do not take this into account, thus leading to great inefficiency, especially as an inventory technique. This was borne out in other herpetological inventories conducted by Accipiter Biological Consultants including those on the Natchez Trace Parkway, Camp Dodge, Iowa Military Training Area, the Blue Ridge Parkway and now at Russell Cave National Monument. In all cases this technique utilized the most time and produced among the fewest individuals.

Between visits in 2004 tornadoes spurred by hurricanes on the Gulf and Eastern Coasts downed a great number of trees along the mountain road on the Park, many falling across the road making it impassible by vehicle. A number of coverboard arrays were damaged or lost due to this cause, certainly adding a bias to the statistical results of this inventory. While affecting a number of random plots on the mountain portions of the Park, this also made traversing the Park on foot much harder and affected many areas which were previously fairly open on the ground under the canopy. Ultimately, the deadfall may produce cover for reptile and amphibian species, however, the dearth of herp species after the storm did not support that thought.

Previous to the 2005 visits a prescribed burn was accomplished over much of the mountain portions of the Park. More coverboard arrays were damaged or destroyed by this fire. Of interest is the fact that, after the burn, no reptiles or amphibians were located under coverboards in the vicinity of the fire during any subsequent visits to the Park. No herp species were located under natural cover or on the surface of the affected area after the burn. It is apparent that this burn did bias the results of this inventory as a number of species were found in the area previous to the burn.

Past Herpetological Surveys of Russell Cave National Monument

During the course of research for this project two previous studies were noted for this park. The first was conducted by James Godwin of the Nature Conservancy, specifically on Localities of the Tennessee Cave Salamander and the second was conducted by Horton H. Hobbs III dealing with ecological resources of the caves on Russell Cave National Monument and of the Chickamauga-Chattanooga National Military Park.

Godwin located three specimens of the Tennessee Cave Salamander at Russell Cave on October 21, 1999. He stated "While this cave system has not been fully surveyed...it (Russell Cave) is nonetheless being regarded as an important site for *G. pallescens*." No additional reptile or amphibian species were mentioned in Godwin's report.

Hobbs listed several reptile and amphibian species located in or near the caves of Russell Cave National Monument. They include Eastern Box Turtle, Tennessee Cave Salamander, Cave Salamander, American Toad and Northern Slimy Salamander. He also mentions *Rana pipiens* at Russell Cave. As of this writing *R. pipiens* is the Northern Leopard Frog. The type now found at the Park is *R. utricularia*, the Southern Leopard Frog. Taxonomists apparently split the Leopard Frog complex into a number of species in the late 1990's.

All species located by these studies were also located on the present inventory so no new species were added to the annotated list by previous studies.

Anecdotal Observation Records

Anecdotal observations are those observations made by other people, outside the study, which may or may not be verified as to the true species observed. The usefulness of this type of data is limited and depends, to a great extent, on the experience of the observer. This being said, a number of species were reported to Accipiter Biological Consultants staff during the surveys by Park visitors and staff. Also, a number of good photographs taken by Park staff exist in three ring binders at the front desk of the Visitor's Center. All species reported to us in this manner and all species we saw in the photographs were found during the course of this inventory, so no new species were added to the annotated list from this source.

After the fieldwork for this project ended, Accipiter Biological Consultants received an email from park employees Mary Shew and Tom Diggs saying that Green Salamanders were found under construction debris in the park. A set of very nice, identifiable photographs accompanied the information. This has been added to the Annotated Checklist for Russell Cave National Memorial on this basis.

During the course of this study a number of NPS employees, especially maintenance workers and rangers, who are out on the Park daily, local inhabitants and visitors to the Park were interviewed in regards to reptile and amphibian species that they had observed on the Park. While this is not a reliable method of gaining information for a study of this type, several interesting conclusions could be drawn from the information.

1. Many local people fear all snakes and feel that all should be killed without delay.
2. Timber Rattlesnakes may have been more prevalent than survey methodologies led us to believe. Many were reported to us but few were found during the surveys.

Taxonomic Issues

Since the beginning of this project, all North American species in the Genus *Eumeces* have been changed to *Plestiodon*. This would include all species of skinks found on the Russell Cave National Monument with the exception of the Ground Skink. Additionally, all lizards of the Genus *Cnemidophorus* residing in North America north of Mexico have been relegated to the Genus *Aspidoscelis*. These changes have been made, where appropriate, in this text.

Of interest to the ABC staff was the inclusion of *Rana pipiens* in the database of NPSpecies for Russell Cave National Monument. This inclusion may have arisen from the Hobbs report cited earlier. As was stated at that time, the notation should be changed to *R. utricularia* to reflect current taxonomy.

SUMMARY

During the course of this inventory 29 species of amphibians and reptiles were documented for Russell Cave National Monument. This 29 species equates to 91% of the 32 species on our original list which have preferred habitat on the Park. Of the original 32 species the Green Salamander, Seal Salamander and Bullfrog were not located. An adult and a juvenile Green Salamander were located and photographed on the park after the conclusion of field work on this project. Potential habitat exists on the Park for the other two species so either of them could be found on the Park in the future. No unexpected species were located during the inventory. The goal of documenting at least 90% of expected reptile and amphibian species was met with this inventory.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS

Throughout history, many human activities have proven detrimental to the natural biota. As human populations increase, more and more natural habitat is eliminated or modified such that many species are now at risk. Several major threats to reptile and amphibian populations exist. The greatest include habitat destruction, modification of hydrologic controls that affect wetlands, pollution and collection for commercial or scientific purposes. The following are a series of conservation and management recommendations aimed at mitigating the effects of these threats on Russell Cave National Monument. These are not meant to be binding on the National Park Service, but rather recommendations for best management practices on the Park.

- As is the case with so many kinds of wildlife, reptiles and amphibians are under great pressure and they are rapidly disappearing from many areas where they were formerly abundant. This is due in the largest part to ignorance of the value of these animals, habitat destruction and exploitation for the pet trade. Current regulations of the National Park Service protect and manage all native wildlife within the National Park System lands. With this progressive attitude in mind, **land managers at Russell Cave National Monument should entirely eliminate the collection of native reptiles and**

amphibians, except as allowed by law through the scientific collecting permit process, and enforce laws relating to killing or harassing of these animals to the highest degree possible.

- During the course of the initial inventory, box turtles were found with profound injuries or dead as the result of run-ins with automobiles and mowers on the Park. When possible, **mowers should be set to cut not less than at an eight-inch height to avoid damaging or killing turtles and snakes utilizing the grassy areas of the Park.** The NPS should investigate the effects of mowing on home range and movement of herp species on the Park.
- **All wetland areas should be managed to preserve, protect and, if necessary, restore natural functions in compliance with Executive Orders 11988 (requires agencies to preserve natural values served by floodplains) and 11990 (requires avoidance of adverse impacts associated with destruction or modification of wetlands), with the objective of minimizing degradation of stream banks and the loss of wetland habitat.**
- **Rights-of-way should be placed near current habitat edge areas to reduce fragmentation of larger blocks of pristine habitat. Avoid building roads or new trails parallel to streams in riparian zones or through wet meadows. Stream crossings should be at right angles to minimize impacts on riparian vegetation, streambanks, soils, and water quality.**
- **Avoid straightening or diverting sections of stream channel. These activities increase stream velocity and erosion, reduce streambank stability, and negatively affect upstream and downstream habitat.**
- **Disturbed wetland areas could be enhanced by revegetation with native plants around the wetland to control erosion and reduce nutrient inputs into the water. All amphibians and many aquatic reptiles are adversely affected by impurities in the water. To this end chemical pesticides and non-biodegradable herbicides should be avoided, especially within 300 feet of any wetland. They should be used only in conjunction with an established Integrated Pest Management Plan.**
- **No ecological benefits are gained by utilizing intensive site preparation activities that cause severe soil disturbance at sites. Therefore, mechanical site preparation activities in susceptible areas should be minimal and restricted to nonmechanical approaches, if possible.** Intensive site preparation activities are known to lead to invasion by invasive exotic weedy species, and to exacerbate erosion problems.
- **During 2003-2005 a baseline inventory of the reptile and amphibian species was accomplished on Russell Cave National Monument. The results of this survey are included in this report. In addition, a monitoring plan for amphibian and reptile species should be developed. This monitoring plan should be implemented as soon as time, personnel and financial resources are available.**

- **Visitors and employees at Russell Cave National Monument should be encouraged to leave microhabitats intact. Rocks, logs, boards and other ground debris should be replaced when disturbed.** These microhabitats form a large share of the usable reptile and amphibian habitat on Park lands. This encouragement could potentially come in the form of notices on Park maps, literature and bulletin boards currently located at a number of pullovers throughout the Park. Brief statements prior to or following the Park film shown in the Visitors Center could also be utilized. These same sources could also be used to **educate visitors and employees on the usefulness of these animals, and to prohibit the harassment of reptiles, amphibians and other native wildlife on Russell Cave National Monument.**

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AMERICAN TOAD

(Bufo americanus)

Status:

Common.

Distribution and Habitat:

These toads are habitat generalists, inhabiting nearly all habitats within the Park.

Special Habitat Requirements:

Requirements include shallow water bodies in which to breed and moist areas in which to hide.

Breeding:

Breeds February through April. The female lays approximately 6000 eggs in two long strings on the bottom of shallow pools. Metamorphosis takes about 2 months.

Food Habits:

This species will eat any insect or invertebrate it can fit into its mouth.

Other Information

Often seen foraging in the woods near the Visitors Center.

FOWLER'S TOAD

(Bufo woodhousii fowleri)

Status:

Abundant

Distribution and Habitat:

These toads are habitat generalists, inhabiting nearly all habitats within Park.

Special Habitat Requirements:

Requirements include sandy areas and shallow water bodies in which to breed.

Breeding:

Breeds March through May. The female lays approximately 7000 eggs in two long strings on the bottom of shallow pools. Eggs hatch in about one week. Metamorphosis takes about 1-2 months.

Food Habits:

This species will eat any insect or invertebrate it can fit into its mouth.

Other Information

Forages in more open areas of the Park than *americanus*.

APPENDIX A

RUCA FIELD DATASHEETS

APPENDIX A KEY

HAB = Habitat

MF = Mixed Hardwood Forest

MH = Mixed Mesic Hardwoods

PH = Pine/Hardwood Forest

OH= Oak/Hickory Forest

OF = Open Field

EP = Ephemeral Pool

SP = Spring

ST = Stream

WR= Wet Rock Faces

SKY = Cloud Cover

0 = Clear or few clouds

1 = Partly cloudy or variable

2 = Cloudy or overcast

4 = Fog or smoke

5 = Drizzle

7 = Snow

8 = Showers

RAIN = Rainfall in last 24 hours

Y = Yes

N= No

= Number of individuals found

AGE

A = Adult

J = Juvenile

L = Larval Stage

U = Unknown

SEX

M = Male

F = Female

U = Unknown

S to V = Snout to Vent Length in mm.

WT = Weight in Grams

* = not weighed

Audio Frog Surveys

HEARD

1 = One frog calling

2 = Two frogs calling

3 = Three frogs calling

4 = Chorus of frogs calling

RUCA GENERAL COLLECTING DATASHEET

DATE	SITE #	HAB	SKY	TEMP	RAIN	SPECIES	#	AGE	SEX	S to V	WT	NOTES
09/10/03	G 1	MH	1	79	N	GREEN FROG	4	A	U	45	8.5	PIC 1
09/10/03	G 1	MH	1	79	N	EASTERN BOX TURTLE	1	A	F	131	266.5	PIC 2
09/12/03	R 11	MH	1	82	N	AMERICAN TOAD	1	J	U	26	1.0	PIC 3
09/12/03	G5	ST	0	76	N	SOUTHERN LEOPARD FROG	8	A	U	45	9.0	PIC 4
09/12/03	G5	ST	0	76	N	GREEN FROG	5	A	U	42	8.0	
09/12/03	G5	ST	0	76	N	TENNESSEE CAVE SALAMANDER	1	A	U	*	*	OBSERVED
04/05/04	G 1	MH	1	64	N	ZIGZAG SALAMANDER	1	A	U	21	*	
04/05/04	G5	ST	1	63	N	SOUTHERN LEOPARD FROG	1	A	U	*	*	OBSERVED
04/05/04	G 2	SP	1	59	N	ZIGZAG SALAMANDER	6	A	U	32	0.5	PIC 6
06/21/04	G4	MH	1	83	N	NORTHERN SLIMY SALAMANDER	2	J	U	33	1.0	RIDLEY CAVE
06/21/04	G3	OF	1	83	N	EASTERN FENCE LIZARD	2	A	F	62	7.0	GRAVID
06/21/04	G5	EP	1	83	N	GREEN FROG	1	A	U	34	5.0	
06/22/04	G3	OF	2	82	Y	EASTERN FENCE LIZARD	1	A	F	61	6.5	PIC 9
06/22/04	G3	OF	2	82	Y	EASTERN BOX TURTLE	1	J	U	57	37.0	
06/22/04	G4	MH	2	82	Y	NORTHERN SLIMY SALAMANDER	2	J	U	31	1.0	
06/22/04	G4	MH	2	82	Y	COPE'S GRAY TREEFROG	1	A	U	43	7.0	
06/22/04	G3	PH	2	82	Y	BLACK KINGSLAKE	1	A	F	960	408.0	
06/22/04	R 11	MF	1	84	Y	FIVE-LINED SKINK	1	A	U	*	*	OBSERVED
09/15/04	G5	EP	1	81	N	SOUTHERN LEOPARD FROG	2	A	U	68	24.0	1JUV.
09/15/04	G5	EP	1	81	N	GREEN FROG	1	L	U	23	4.0	
09/15/04	G3	OF	2	84	N	FIVE-LINED SKINK	1	A	F	53	2.5	
09/15/04	G3	OF	2	84	N	EASTERN FENCE LIZARD	1	A	F	61	*	ESCAPED
09/15/04	G4	SP	2	84	N	SOUTHERN LEOPARD FROG	4	A	U	58	13.0	
09/15/04	G4	MH	2	84	N	NORTHERN SLIMY SALAMANDER	1	A	U	54	4.0	
09/15/04	G3	OF	2	84	N	EASTERN BOX TURTLE	1	A	M	142	314.0	
09/15/04	R7	WR	2	85	N	CAVE SALAMANDER	1	A	U	48	1.5	PIC 24
09/16/04	R6	OH	1	76	Y	SMOOTH EARTH SNAKE	1	A	M	202	4.5	PIC 23
09/16/04	G1	MH	1	77	Y	EASTERN GARTER SNAKE	1	A	F	482	21.0	
09/16/04	G1	MH	1	77	Y	AMERICAN TOAD	2	J	U	39	5.0	
09/16/04	R4	PH	1	78	Y	NORTHERN SLIMY SALAMANDER	3	A	U	67	5.0	
09/16/04	R7	MH	1	78	Y	TIMBER RATTLESNAKE	1	J	U	*	*	OBSERVED
09/16/04	R8	MH	1	78	Y	RINGNECK SNAKE	1	A	M	302	8.0	
09/16/04	R11	MH	1	78	Y	FIVE-LINED SKINK	1	A	F	68	10.0	PIC 8
09/16/04	G3	OF	1	78	Y	EASTERN FENCE LIZARD	5	A	F	72	8.0	3 JUV.
09/16/04	G3	OF	1	78	Y	EASTERN GARTER SNAKE	1	A	U	*	*	OBSERVED
09/16/04	G3	OF	1	78	Y	FIVE-LINED SKINK	2	J	U	*	*	OBSERVED
06/29/05	G2	SP	2	88	N	SOUTHERN LEOPARD FROG	8	A	U	24	1.0	
06/29/05	G1	SP	2	89	N	GREEN FROG	1	A	U	46	8.0	
06/29/05	G4	MF	1	87	N	CAVE SALAMANDER	1	A	U	52	1.5	
06/30/05	G3	OF	1	89	N	FOWLER'S TOAD	1	J	U	22	*	
06/30/05	M1	ST	1	89	N	EASTERN NARROW-MOUTHED TOAD	1	A	U	22	0.5	
06/30/05	M1	ST	1	89	N	CAVE SALAMANDER	1	J	U	34	0.5	
DATE	SITE #	HAB	SKY	TEMP	RAIN	SPECIES	#	AGE	SEX	S to V	WT	NOTES

RUCA GENERAL COLLECTING DATASHEET

06/30/05	M1	ST	1	89	N	NORTHERN SLIMY SALAMANDER	1	J	U	34	0.5	
07/01/05	M1	EP	1	82	N	FOWLER'S TOAD	500	L	U	14	0.5	
07/01/05	M1	EP	1	82	N	FOWLER'S TOAD	2	A	U	56	16.0	PIC 7
07/01/05	G4	WR	1	82	N	SOUTHERN TWO-LINED SALAMANDER	2	A	U	31	0.5	PIC 22
07/01/05	G4	ST	1	82	N	COPE'S GRAY TREEFROG	1	A	M	49	9.0	PIC 10
07/01/05	G3	OF	1	84	N	FIVE-LINED SKINK	3	A	M	63	7.0	
07/01/05	G3	OF	1	84	N	GROUND SKINK	1	A	U	34	1.0	PIC 25
07/01/05	G3	MH	1	84	N	COPPERHEAD	1	A	U	*	*	OBSERVED
07/01/05	G3	OF	1	84	N	EASTERN BOX TURTLE	1	A	F	128	402.0	
09/06/05	G4	SP	1	78	N	PICKEREL FROG	1	A	U	59	13.0	PIC 19

RUCA ANURAN AUDIO DATASHEET

DATE	SITE #	HAB	SKY	TEMP	RAIN	SPECIES	#	NOTES
04/05/04	G2	SP	1	60	N	UPLAND CHORUS FROG	4	
04/05/04	G1	MH	1	59	N	GREEN FROG	2	
04/05/04	G4	ST	1	59	N	PICKEREL FROG	2	
04/05/04	G4	ST	1	59	N	SOUTHERN LEOPARD FROG	3	
04/05/04	G4	ST	1	59	N	BARKING TREEFROG	1	
04/05/04	R12	MH	1	57	N	SPRING PEEPER	4	
06/22/04	G4	MH	2	79	Y	GREEN FROG	1	
06/22/04	G4	MH	2	79	Y	BARKING TREEFROG	2	
06/22/04	G3	PH	2	82	Y	COPE'S GRAY TREEFROG	2	
09/13/04	G2	SP	2	73	Y	FOWLER'S TOAD	3	
09/13/04	G5	EP	2	73	Y	SOUTHERN LEOPARD FROG	2	
09/13/04	G5	EP	2	73	Y	GREEN FROG	1	
06/29/05	G4	ST	2	88	N	COPE'S GRAY TREEFROG	3	
06/29/05	M1	ST	2	88	N	FOWLER'S TOAD	3	
06/29/05	M1	ST	2	88	N	SOUTHERN LEOPARD FROG	2	

RUCA MINNOW TRAP DATASHEET

DATE	SITE #	HAB	SKY	TEMP	RAIN	SPECIES	#	AGE	SEX	S to V	WT	NOTES
06/22/04	M2	ST	2	82	Y	GREEN FROG	1	A	U	33	4.5	
06/22/04	M1	EP	2	84	Y	GREEN FROG	47	L	U	41	3.0	
06/22/04	M1	EP	2	84	Y	AMERICIAN TOAD	8	L	U	8	*	
06/23/04	M1	EP	2	80	Y	GREEN FROG	39	L	U	44	3.5	
06/23/04	M1	EP	2	80	Y	AMERICIAN TOAD	6	L	U	6	*	
06/24/04	M1	EP	5	76	Y	GREEN FROG	22	L	U	28	2.5	
06/24/04	M1	EP	5	76	Y	AMERICIAN TOAD	7	L	U	6	*	
09/14/04	M1	EP	2	78	N	SOUTHERN LEOPARD FROG	8	L	U	4	*	
09/14/04	M1	EP	2	78	N	GREEN FROG	12	L	U	32	7.0	
09/14/04	M1	EP	2	78	N	AMERICIAN TOAD	2	L	U	6	*	
09/15/04	M1	EP	2	72	N	GREEN FROG	3	L	U	35	8.0	
09/15/04	M1	EP	2	72	N	AMERICIAN TOAD	2	L	U	6	*	
09/15/04	M2	ST	2	73	N	MIDLAND WATERSNAKE	1	J	F	312	24.0	PIC 20
07/01/05	M1	EP	1	82	N	FOWLER'S TOAD	42	L	U	5	*	
07/01/05	M1	EP	1	82	N	SOUTHERN LEOPARD FROG	1	A	U	38	2.5	

RUCA RANDOM PLOT DATASHEET

DATE	SITE #	HAB	SKY	TEMP	RAIN	SPECIES	#	AGE	SEX	S to V	WT	NOTES
04/05/04	R 8	MH	1	63	N	NORTHERN SLIMY SALAMANDER	1	A	U	72	8.5	PIC 5
06/23/04	R11	MF	1	84	Y	RINGNECK SNAKE	1	A	M	407	13.0	
06/23/04	R9	MH	1	80	Y	RINGNECK SNAKE	1	A	F	337	8.0	
09/15/04	R9	MH	2	75	N	RAT SNAKE	1	A	F	1028	402.0	PIC 17
09/15/04	R9	MH	2	75	N	NORTHERN SLIMY SALAMANDER	1	A	U	85	12.0	
09/15/04	R6	OH	2	76	N	EASTERN GARTER SNAKE	1	J	M	202	3.0	PIC 18
09/15/04	R1	OH	2	76	N	NORTHERN SLIMY SALAMANDER	2	A	U	60	5.0	
09/03/05	R9	MH	0	84	N	EASTERN GARTER SNAKE	1	A	M	520	54.0	
09/06/05	R11	MH	0	85	N	RINGNECK SNAKE	2	A	F	280	5.5	1 JUV

APPENDIX B

**ANNOTATED
CHECKLIST OF
THE REPTILE AND
AMPHIBIAN
SPECIES OF
RUSSELL CAVE
NATIONAL
MONUMENT**

ANNOTATED REPTILE AND AMPHIBIAN CHECKLIST KEY

Native

N = Native to RUCA-- Native; includes endemic or indigenous

I = Introduced to RUCA

Park Status

P = Present-- Extremely high confidence in park; Current, verifiable evidence exists; Extant.

PP = Probably Present-- Very high confidence in park; Verifiable evidence may exist, but not current; Park within range; Appropriate habitat exists; Adjacent to park.

H = Historical-- Extremely low confidence in park; Verifiable evidence exists but not current.

U = Unconfirmed-- Very low to high confidence in park; Verifiable evidence may exist, but not current or insufficient.

? = Unknown

Residency

R = Resident on the Park

B = Positive Breeder on the Park—Reproduces.

U = Unknown

Abundance

A = Abundant-- Large numbers; Habitats covering large portion of park.

C = Common-- Large numbers; Habitats not covering large portion of park.

U = Uncommon-- Few to moderate numbers; Sporadic; Habitats uncommon in park.

R = Rare-- Few individuals; Habitats rare.

? = Unknown

Previous Studies

G = Godwin (2000)

H = Hobbs (1994)

Voucher Exists

P = Photographic voucher obtained during this study

Other

A = Anecdotal record for the Park

ANNOTATED REPTILE AND AMPHIBIAN CHECKLIST	NATIVE	PARK STATUS	RESIDENCY	ABUNDANCE	FOUND 2003/2005	PREVIOUS STUDIES	VOUCHER EXISTS	OTHER
Order Caudata - Salamanders								
Plethodontidae – Lungless Salamanders								
Zigzag Salamander – <i>Plethodon dorsalis</i>	N	P	R	C	X		P	A
Northern Slimy Salamander – <i>Plethodon glutinosus</i>	N	P	B	C	X	H	P	A
Green Salamander – <i>Aneides aeneus</i>	N	P	B	U	*		P	A
Tennessee Cave Salamander – <i>Gyrinophilus palleucus</i>	N	P	R	U	X	G,H		
Southern Two-lined Salamander - <i>Eurycea cirrigera</i>	N	P	R	U	X		P	
Longtail Salamander – <i>Eurycea longicauda</i>	N	P	R	U	X		P	
Cave Salamander – <i>Eurycea lucifuga</i>	N	P	B	C	X	H	P	A
Order Anura – Frogs and Toads								
Bufonidae – True Toads								
American Toad - <i>Bufo americanus</i>	N	P	B	C	X	H	P	A
Fowler’s Toad - <i>Bufo woodhousii fowleri</i>	N	P	B	A	X		P	A
Hylidae – Treefrogs and Allies								
Barking Treefrog – <i>Hyla gratiosa</i>	N	P	B	U	X			
Cope’s Gray Treefrog - <i>Hyla chrysoscelis</i>	N	P	B	C	X		P	A
Spring Peeper - <i>Pseudacris crucifer</i>	N	P	B	C	X			
Upland Chorus Frog - <i>Pseudacris triseriata</i>	N	P	B	C	X			
Microhylidae – Narrowmouth Toads								
Eastern Narrowmouth Toad – <i>Gastrophryne carolinensis</i>	N	P	R	U	X			
Ranidae – True Frogs								
Green Frog - <i>Rana clamitans melanota</i>	N	P	B	A	X		P	
Southern Leopard Frog – <i>Rana utricularia</i>	N	P	B	C	X	H	P	A
Pickerel Frog – <i>Rana palustris</i>	N	P	R	U	X		P	

ANNOTATED REPTILE AND AMPHIBIAN CHECKLIST	NATIVE	PARK STATUS	RESIDENCY	ABUNDANCE	FOUND 2003/2005	PREVIOUS STUDIES	VOUCHER EXISTS	OTHER
Order Testudines - Turtles								
Emydidae – Box and Water Turtles								
Eastern Box Turtle - <i>Terrapene carolina carolina</i>	N	P	B	C	X	H	P	A
Order Squamata – Lizards and Snakes								
Suborder Lacertilia – Lizards								
Phrynosomatidae – Spiny Lizards and Allies								
Eastern Fence Lizard - <i>Sceloporus undulatus</i>	N	P	B	A	X		P	A
Scincidae – Skinks								
Five-lined Skink - <i>Plestiodon fasciatus</i>	N	P	B	C	X		P	A
Ground Skink – <i>Scincella lateralis</i>	N	P	R	U	X		P	
Suborder Serpentes - Snakes								
Colubridae – Colubrids								
Midland Watersnake - <i>Nerodia sipedon pleuralis</i>	N	P	B	U	X		P	
Eastern Garter Snake - <i>Thamnophis sirtalis</i>	N	P	B	C	X		P	A
Smooth Earth Snake – <i>Virginia valeriae</i>	N	P	R	U	X		P	A
Ringneck Snake - <i>Diadophis punctatus</i>	N	P	B	C	X		P	
Eastern Worm Snake - <i>Carphophis amoenus</i>	N	P	B	U	X		P	
Rat Snake - <i>Elaphe obsoleta</i>	N	P	R	U	X		P	A
Black Kingsnake – <i>Lampropeltis getula nigra</i>	N	P	R	U	X			A
Viperidae - Vipers								
Crotalinae – Pit Vipers								
Copperhead - <i>Agkistrodon contortrix</i>	N	P	R	U	X			A
Timber Rattlesnake - <i>Crotalus horridus</i>	N	P	B	U	X			A

APPENDIX C

**LIFE HISTORY
INFORMATION OF
THE REPTILE AND
AMPHIBIAN
SPECIES OF
RUSSELL CAVE
NATIONAL
MONUMENT**

ZIGZAG SALAMANDER

(Plethodon dorsalis)

Status:

Common.

Distribution and Habitat:

This species inhabits seepages near rock outcroppings on slopes in mixed hardwood forests.

Special Habitat Requirements:

Requirements include talus slopes, rocky hillsides and other habitats with rocky substrates in mesic forests.

Breeding:

Breeding occurs from fall to midspring. Females deposit 1-10 eggs in underground retreats in late spring or early summer and attend them until hatching some 90 days later. The young are miniature replicas of the adults and are terrestrial.

Food Habits:

This species eats primarily spiders, beetles, mites and other small arthropods.

Other Information

Look for this species in appropriate habitats in the mountain portions of the Park.

NORTHERN SLIMY

SALAMANDER

(Plethodon glutinosus)

Status:

Common

Distribution and Habitat:

This species inhabits moist woodland habitats which are not susceptible to flooding. They should be found throughout the Park.

Special Habitat Requirements:

This species generally requires more moisture than other salamanders of this genus.

Breeding:

Eggs are laid in late summer or fall in or under logs and among roots. Young do not have an aquatic stage.

Food Habits:

Invertebrates including earthworms, beetles and ants are the mainstay of the diet.

Other Information

This species is often found by turning logs or flat rocks in their preferred habitat.

TENNESSEE CAVE
SALAMANDER
(*Gyrinophilus pallescens*)

Status:

Uncommon.

Distribution and Habitat:

This species lives in or near caves in the Park. Specimens may be found in shallow pools and in either rocky or sandy substrates.

Special Habitat Requirements:

Requirements include caves with sinkholes providing relatively high nutrient input and a large invertebrate population to sustain the salamander population.

Breeding:

Mating season and courtship is unknown, however, females appear to have irregular breeding patterns and may skip one or more years before breeding again. Eggs have not been located but hatchlings found in December and February suggest that females oviposit in autumn or early winter.

Food Habits:

Food consists of a variety of small aquatic invertebrates and their larvae. Amphipods are the most frequent prey, followed by isopods, chironomid larvae and earthworms.

Other Information

Only one specimen was located during this inventory. Surprisingly enough, it was located outside of the cave proper in a small sinkhole which entered under a very large rock face about 125 feet in front of the mouth of Russell Cave.

SOUTHERN TWO-LINED
SALAMANDER
(*Eurycea cirrigera*)

Status:

Uncommon.

Distribution and Habitat:

This species lives in or near springs, seepages and streams in hardwood forests and swamps in the Park.

Special Habitat Requirements:

Requirements include rocks or logs in their preferred habitat under which to hide and rocks or logs in running water for egg laying.

Breeding:

Mating occurs in the fall, and eggs are laid in the winter or early spring. The female deposits a flat cluster of eggs on the underside of rocks or logs in running water. The female remains with the eggs until the aquatic larvae hatch. Larval period lasts from 1-3 years.

Food Habits:

Food consists of small terrestrial or aquatic invertebrates and their larvae.

Other Information

This species was most commonly located in or near small streams or seeps by turning logs and rocks

LONGTAIL SALAMANDER

(Eurycea longicauda)

Status:

Uncommon.

Distribution and Habitat:

This species lives in or near the margins of shaded seeps, springs or streams and sometimes in forested situations.

Special Habitat Requirements:

Requirements include rocks or logs in their preferred habitat under which to hide and shaded waterways for larval stages.

Breeding:

Mating occurs in the fall or early winter. Females lay approximately 90 eggs which are attached to stones, roots or boards in running water or suspended above the water. Hatching occurs in 4-12 weeks. Larval period lasts from 4-7 months.

Food Habits:

Food consists of a wide variety of small terrestrial or aquatic invertebrates and their larvae.

Other Information

This species should be looked for under rocks and logs in appropriate habitat.

CAVE SALAMANDER

(Eurycea lucifuga)

Status:

Common.

Distribution and Habitat:

This species occurs on or near rock faces in conjunction with streams or caves. Many times they may be found in debris at the bottom of the rock face or in forested areas nearby.

Special Habitat Requirements:

Requirements include rock faces with varied fissures and cracks and nearby rocks and logs under which to hide and shaded waterways for larval stages.

Breeding:

Oviposition occurs in the fall or early winter. Females lay single eggs which are attached by a stalk to the side of small rimstone pools. Eggs number from 60-120. Larval period lasts from 6-18 months.

Food Habits:

Food consists of a wide variety of small terrestrial or aquatic invertebrates and their larvae.

Other Information

This species should be looked for under rocks and logs and on rock faces near the entrances to Russell and Ridley Caves.

AMERICAN TOAD

(Bufo americanus)

Status:

Common.

Distribution and Habitat:

These toads are habitat generalists, inhabiting nearly all habitats within the Park.

Special Habitat Requirements:

Requirements include shallow water bodies in which to breed and moist areas in which to hide.

Breeding:

Breeds February through April. The female lays approximately 6000 eggs in two long strings on the bottom of shallow pools. Metamorphosis takes about 2 months.

Food Habits:

This species will eat any insect or invertebrate it can fit into its mouth.

Other Information

Often seen foraging in the woods near the Visitors Center.

FOWLER'S TOAD

(Bufo woodhousii fowleri)

Status:

Abundant

Distribution and Habitat:

These toads are habitat generalists, inhabiting nearly all habitats within Park.

Special Habitat Requirements:

Requirements include sandy areas and shallow water bodies in which to breed.

Breeding:

Breeds March through May. The female lays approximately 7000 eggs in two long strings on the bottom of shallow pools. Eggs hatch in about one week. Metamorphosis takes about 1-2 months.

Food Habits:

This species will eat any insect or invertebrate it can fit into its mouth.

Other Information

Forages in more open areas of the Park than *americanus*.

BARKING TREEFROG

(Hyla gratiosa)

Status:

Uncommon.

Distribution and Habitat:

Occupies areas with shallow bodies of water and low, wet woods within the Park.

Special Habitat Requirements:

Requirements include emergent vegetation in unpolluted water bodies.

Breeding:

Breeding takes place from May to August. Females deposit approximately 2000 eggs singly on the bottom of a pond.. Hatching occurs in 5 days and metamorphosis occurs in 40-70 days.

Food Habits:

The diet consists of arboreal insects.

Other Information

This frog is seldom seen outside of the breeding season. It may be heard singing in appropriate habitats within the Park.

COPE'S GRAY TREEFROG

(Hyla chrysoscelis)

Status:

Common.

Distribution and Habitat:

Occupies areas with small trees or shrubs near or standing in shallow bodies of water within the Park.

Special Habitat Requirements:

Requirements include emergent vegetation in unpolluted water bodies.

Breeding:

Breeding takes place from May to August. Scattered groups of 10-40 eggs are laid on the surface of shallow ditches, puddles and ponds. Hatching occurs in 5 days and metamorphosis occurs in about 50 days.

Food Habits:

The diet consists of arboreal insects.

Other Information

This frog is seldom seen outside of the breeding season. It may be heard singing in appropriate habitats within the Park.

SPRING PEEPER

(Hyla crucifer)

Status:

Common.

Distribution and Habitat:

Occupies woodlands near temporary or semi permanent ponds or swamps throughout the Park.

Special Habitat Requirements:

Requirements include second growth or cutover woodlots near unpolluted water body.

Breeding:

Breeding takes place from October through March. About 900 eggs are attached singly to submerged objects in shallow water. Eggs hatch in 5-7 days and metamorphosis occurs in 3-4 months.

Food Habits:

The diet consists of small arthropods.

Other Information

This frog is seldom seen outside of the breeding season. It may sometimes be seen wandering in woody areas after rains. More often heard than seen.

UPLAND CHORUS FROG

(Pseudacris triseriata)

Status:

Common

Distribution and Habitat:

This species inhabits grassy swales, moist woodlands, river bottom swamps and the environs of ponds, bogs and marshes.

Special Habitat Requirements:

Semi-permanent pools are required for breeding.

Breeding:

Breeds December through March. Females lay about 1000 eggs in clusters of 60 each. Eggs are attached to vegetation with metamorphosis in 2-3 months.

Food Habits:

Small arthropods are eaten.

Other Information

This species may be active year around in suitable habitats throughout the Park.

EASTERN NARROWMOUTH TOAD

(Gastrophryne carolinensis)

Status:

Uncommon.

Distribution and Habitat:

Occupies areas containing logs, rocks, boards or burrows under which they may hide.

Special Habitat Requirements:

Requirements include containing logs, rocks, boards or burrows under which they may hide.

Breeding:

Breeding takes place from May through July. Packets of about 850 eggs are layed on the surface of the water. Eggs hatch in 5-7 days and metamorphosis occurs in 20-70 days.

Food Habits:

The diet consists primarily of ants.

Other Information

This species is very secretive, entirely terrestrial and more often heard than seen.

GREEN FROG *(Rana clamitans melanota)*

Status:

Abundant

Distribution and Habitat:

This species inhabits shallow fresh water habitats throughout the Park. Streams and brooks are preferred.

Special Habitat Requirements:

Requirements include shallow and unpolluted water bodies.

Breeding:

Breeding takes place in May and June. The female lays about 3000 eggs in a raftlike surface film. Most tadpoles transform within a few months, but, some overwinter.

Food Habits:

The diet consists primarily of arthropods, snails and worms.

Other Information

The banjo-like twang of their call is often heard within the Park. It is readily seen at most water bodies within the Park.

SOUTHERN LEOPARD FROG

(Rana utricularia)

Status:

Common.

Distribution and Habitat:

This species inhabits shallow fresh water habitats throughout the Park. Streams and ponds are preferred.

Special Habitat Requirements:

Requirements include shallow and unpolluted water bodies.

Breeding:

Breeding takes place in winter or early spring. The female attaches a firm cluster of several hundred eggs to vegetation just below the water surface. Eggs hatch in 7-14 days. Most tadpoles transform within a few months, but, some overwinter.

Food Habits:

The diet consists primarily of insects.

Other Information

This species is easily found at any pond in the Park.

PICKEREL FROG

(Rana palustris)

Status:

Uncommon.

Distribution and Habitat:

This species inhabits sphagnum bogs, rocky ravines, meadow streams and a wide variety of other habitats near water throughout the Park.

Special Habitat Requirements:

Semi-permanent pools with vegetation are required for breeding.

Breeding:

Breeds April through May. Females lay about 3000 eggs in a round mass attached to aquatic plants. Metamorphosis occurs in 70-80 days.

Food Habits:

Insects and smaller frogs are the main food sources. .

Other Information

This species may be readily observed as it ventures well away from water during the summer when vegetation can provide shelter and shade.

EASTERN BOX TURTLE

(Terrapene carolina carolina)

Status:

Common.

Distribution and Habitat:

This species is largely terrestrial and they utilize forested habitats and field edges throughout the Park.

Special Habitat Requirements:

While being largely terrestrial, they do need water close at hand in which to soak.

Breeding:

Females lay 3-8 eggs in June or July. A shallow nest is made in loose soil.

Food Habits:

A wide variety of plants and small animals are eaten.

Other Information

This species is often seen foraging along the roads, especially after rains.

EASTERN FENCE LIZARD

(Sceloporus undulatus)

Status:

Abundant.

Distribution and Habitat:

This species inhabits open pine and mixed woods, building sites and fences at lower elevations.

Special Habitat Requirements:

Requirements include open areas with plenty of sunlight.

Breeding:

Females lay from 6-10 eggs in late spring in burrows under rotten logs. Second clutches are sometimes produced in early summer.

Food Habits:

This species eats arthropods such as spiders, crickets, grasshoppers, beetles and snails.

Other Information

Most often observed sunning on rail fences in developed portions of the Park.

FIVE-LINED SKINK

(Plestiodon fasciatus)

Status:

Common.

Distribution and Habitat:

This species inhabits moist, wooded areas throughout the Park.

Special Habitat Requirements:

Requirements include damp areas, dead trees and snags where insects are abundant.

Breeding:

Females lay from 6-12 eggs in June in nests in rotten wood or under rocks.

Food Habits:

This species eats arthropods such as spiders, crickets, grasshoppers and beetles.

Other Information

Most often observed sunning on fences in developed portions of the Park.

GROUND SKINK

(Scincella lateralis)

Status:

Uncommon.

Distribution and Habitat:

This species inhabits disturbed areas and open woodlands at lower elevations.

Special Habitat Requirements:

Requirements include areas of leaf litter or detritus in which to forage.

Breeding:

Two or more clutches of from 1-7 eggs are laid in burrows under leaf litter.

Food Habits:

This species eats primarily small insects and spiders.

Other Information

Look for this species in appropriate habitats throughout the Park.

MIDLAND WATERSNAKE

(Nerodia sipedon pleuralis)

Status:

Uncommon.

Distribution and Habitat:

This species inhabits swamps, marshes, streams, ponds and lakes throughout the Park.

Special Habitat Requirements:

This species requires quiet water with fish populations.

Breeding:

Eight to fifty young are born live in late summer.

Food Habits:

This species actively seeks fish and amphibians as the chief food items.

Other Information

This species is often observed basking on logs or overhanging limbs at the water's edge.

EASTERN GARTER SNAKE

(Thamnophis sirtalis)

Status:

Common.

Distribution and Habitat:

This species is a habitat generalist and may be found in meadows, marshes, woodlands, hillsides, and along streams and ditches throughout the Park.

Special Habitat Requirements:

This species is most often associated with moist environments and is sensitive to pollution.

Breeding:

Seven to more than one hundred young are born live in late summer.

Food Habits:

Earthworms, fish and amphibians form the bulk of the diet.

Other Information

Most often seen foraging on forest floors during the day.

SMOOTH EARTH SNAKE

(Virginia valeriae)

Status:

Uncommon.

Distribution and Habitat:

This species frequents open forested habitats and forest edges with decaying logs or stumps throughout the Park.

Special Habitat Requirements:

This species needs logs, stones or other surface cover under which to hide.

Breeding:

Two to fourteen young per litter are born in the summer.

Food Habits:

Earthworms are its chief food source.

Other Information

These small snakes are most often located by turning rocks and logs in wooded areas of the Park.

RINGNECK SNAKE

(Diadophis punctatus)

Status:

Common.

Distribution and Habitat:

This species frequents forested habitats with decaying logs or stumps throughout the Park.

Special Habitat Requirements:

While not aquatic, these snakes prefer areas where there is evidence of moisture such as around springs, damp forested hillsides and poorly drained pine woods.

Breeding:

Females lay from 1-10 eggs in sawdust piles, rotten logs or in damp soil under flat stones.

Food Habits:

Earthworms and small salamanders are the principal foods, but frogs, lizards and other small snakes are sometimes eaten.

Other Information

These snakes are almost entirely nocturnal. Individuals may be observed on the Park at night, especially during or following rains.

EASTERN WORM SNAKE

(Carphophis amoenus)

Status:

Uncommon. This species could be more common on the Park than is indicated by this inventory survey. Very secretive.

Distribution and Habitat:

This species frequents moist, forested habitats at low to medium elevations and should be found throughout the Park.

Special Habitat Requirements:

Requires moist earth and will bury deep underground in dry weather.

Breeding:

Females lay from 2-8 eggs in sawdust piles or rotten logs in early summer.

Food Habits:

Earthworms and soft bodied insects are the principal foods of this diminutive species.

Other Information

The best way to find these snakes is to turn over logs or flat rocks in moist woods.

RAT SNAKE

(Elaphe obsoleta)

Status:

Uncommon.

Distribution and Habitat:

This species inhabits rocky timbered hillsides to flat open fields throughout the Park.

Special Habitat Requirements:

Generally found near wooded areas.

Breeding:

Females lay from 5-25 eggs in or under rotten logs, stumps or sawdust piles in late spring or early summer.

Food Habits:

Small mammals, birds and their eggs, frogs and lizards are eaten.

Other Information

These snakes may be seen foraging during the day.

BLACK KINGSNAKE

(Lampropeltis getula nigra)

Status:

Uncommon.

Distribution and Habitat:

This species may inhabit nearly all available habitats at lower elevations throughout the Park.

Special Habitat Requirements:

Requires surface cover under which to hide.

Breeding:

Females lay from 5-20 eggs in or under rotten logs and similar places.

Food Habits:

Small mammals and other snakes are the principal food sources, although birds and some amphibians are also eaten.

Other Information

These snakes may be seen foraging during the day.

COPPERHEAD

(Agkistrodon contortrix)

Status:

Uncommon.

Distribution and Habitat:

This species inhabits woodlands throughout the Park.

Special Habitat Requirements:

Requires surface cover under which to hide.

Breeding:

Three to fourteen young are born live in late summer after spring mating.

Food Habits:

Insects, amphibians, reptiles, birds and small mammals are eaten.

Other Information

Often seen on the forest floor during the day.

TIMBER RATTLESNAKE
(*Crotalus horridus*)

Status:

Uncommon. This species may be more common on the Park than surveys from this inventory indicate.

Distribution and Habitat:

This species inhabits rocky hillsides, fields bordered by forests and low pinewoods throughout the Park.

Special Habitat Requirements:

Usually most common in second growth forested areas where rodents abound.

Breeding:

Five to nineteen young are born live in late summer after mating in early spring.

Food Habits:

Small mammals, especially rodents, are the chief food.

Other Information

This species is most often reported from the developed areas of the Park where their presence is more easily detected.

GREEN SALAMANDER
(*Aneides aeneus*)

Status:

Uncommon. This species may be more common on the Park than surveys from this inventory indicate.

Distribution and Habitat:

This species occurs on or near rock faces in conjunction with streams or caves. At times they may be found in debris at the bottom of the rock face or in forested areas nearby.

Special Habitat Requirements:

Requirements include rock faces with varied fissures and cracks and nearby rocks and logs under which to hide.

Breeding:

Ten to 27 eggs are laid in an adhesive glob on the top of fissures in rock faces. Females brood and protect eggs for 67-82 days. Young are born terrestrial.

Food Habits:

Food consists of a wide variety of small terrestrial invertebrates and their larvae.

Other Information

This species should be looked for under rocks and logs and on rock faces near the entrances to Russell and Ridley Caves. Individuals located by Park staff were located under construction debris.

APPENDIX D

RUCA PHOTOGRAPHIC VOUCHER PICTURE LOG

RUCA PHOTOGRAPHIC VOUCHER PICTURE LOG

ABC PHOTO #	COMMON NAME	SCIENTIFIC NAME	DATE	COORDINATES
1	Green Frog	<i>Rana clamitans melanota</i>	9/10/03	16 S 608215 3871139
2	Eastern Box Turtle	<i>Terrapene carolina carolina</i>	9/10/03	16 S 608215 3871139
3	American Toad	<i>Bufo americanus</i>	9/12/03	16 S 608547 3871362
4	Southern Leopard Frog	<i>Rana utricularia</i>	9/12/03	16 S 608646 3871167
5	Northern Slimy Salamander	<i>Plethodon glutinosus</i>	4/5/04	16 S 608229 3871051
6	Zigzag Salamander	<i>Plethodon dorsalis</i>	4/5/04	16 S 607896 3870084
7	Fowler's Toad	<i>Bufo woodhousii fowleri</i>	7/1/05	16 S 608646 3871167
8	Five-lined Skink	<i>Plestiodon fasciatus</i>	9/16/04	16 S 608547 3871362
9	Eastern Fence Lizard	<i>Sceloporus undulatus</i>	6/22/04	16 S 608650 3871489
10	Cope's Gray Treefrog	<i>Hyla chrysoscelis</i>	7/1/05	16 S 608426 3871556
13	Ring-necked Snake	<i>Diadophis punctatus</i>	6/23/04	16 S 608332 3871524
16	Eastern Worm Snake	<i>Carphophis amoenus</i>	9/15/04	16 S 608332 3871524
17	Rat Snake	<i>Elaphe obsoleta</i>	9/15/04	16 S 608330 3871313
18	Eastern Garter Snake	<i>Thamnophis sirtalis</i>	9/15/04	16 S 607934 3870774
19	Pickerel Frog	<i>Rana palustris</i>	9/6/05	16 S 608426 3871556
20	Midland Watersnake	<i>Nerodia sipedon pleuralis</i>	9/15/04	16 S 608426 3871556
21	Longtail Salamander	<i>Eurycea longicauda</i>	9/15/04	16 S 608354 3871533
22	Southern Two-lined Salamander	<i>Eurycea cirrigera</i>	7/1/05	16 S 608426 3871556
23	Smooth Earth Snake	<i>Virginia valeriae</i>	9/16/04	16 S 607934 3870774
24	Cave Salamander	<i>Eurycea lucifuga</i>	9/15/04	16 S 607971 3871068
25	Ground Skink	<i>Scincella lateralis</i>	7/1/05	16 S 608650 3871489