FINAL REPORT:
REPTILE AND AMPHIBIAN INVENTORIES IN EIGHT PARKS IN THE NATIONAL CAPITAL REGION

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Submitted to:

Inventory and Monitoring Program
National Capital Region Network
Center for Urban Ecology
Washington D.C.
TIC #: NCRO-D-61

July 12, 2005

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EXECUTIVE SUMMARY

Inventories to ascertain amphibian and reptile species that occur in 7 parks and reptile species in 1 park in the National Capital Region were conducted from spring 2002 through fall 2004. Occurrences of amphibians and reptiles were studied in Catoctin Mountain Park (CATO), George Washington Memorial Parkway (GWMP), Harpers Ferry National Historic Park (HAFE), Manassas Battlefield Park (MANA), Monocacy National Battlefield Park (MONO), Rock Creek Park (ROCR), and Wolf Trap National Park for the Performing Arts (WOTR). Reptile inventories were conducted in the Chesapeake and Ohio National Historic Park (CHOH). Only reptile inventories were conducted at the Chesapeake and Ohio National Historic Park (CHOH) since Don Forester (2000) and Ed Thompson (2000) had previously conducted inventories for amphibians. Prior to this study, few herpetological inventories had been conducted in most parks.

Year one of this 3-year study included reconnaissance of habitats throughout all parks and limited inventories. Studies conducted during this year allowed investigators to become familiar with the area and to locate habitats to be studied in detail. Years 2 through 3 included more detailed inventories of amphibians and reptiles. Inventories were designed to reveal species diversity.

Objectives of inventories were to (1) document 90% of the amphibians (frogs and salamanders) and reptiles (turtles, lizards, and snakes) and (2) describe their habitats, and (3) present conservation and management recommendations to the staff of each park. Inventory methods included visual and aural observations, searches with dipnets, and turtle traps.

Cumulative documented species counts for all 8 parks are as follows: salamanders (14 species); frogs (11 species); turtles (7 species); lizards (3 species); and snakes (15 species). Based on the potential species list, the percentage of species documented for all parks combined during inventories in this study was 83% for salamanders, 85% for frogs, 70% for turtles, 60% for lizards, and 79% for snakes. Given the difficulty in finding most species of reptiles and results of other studies in National Parks in the Eastern United States, these percentages represent reasonable results.

A specific section describing results for each of the 8 parks is included in this report (Appendices 2 – 9). Sections for each park include table of contents, introduction, methods, results and discussion, conclusions and recommendations, and literature cited. The section on results and discussion addresses potential species, species summary, habitats, and comments about each taxonomic group (salamanders, frogs and toads, turtles, lizards, and snakes). A database with detailed information about each species per park is included as Appendix 10.

Twenty-two habitat types inhabited by amphibian and reptiles in the parks of the National Capital Region were identified during these field studies. Terrestrial habitats included road cuts, rock piles, floodplains, railroad tunnels, emergent rocks and boulder fields, rock outcrops, trails and roads, old fields and rights-of-way, and forests (mixed deciduous and mixed deciduous and pine). Aquatic habitats consisted of first-order/intermittent streams, second- and third-order streams, rivers, springs/seeps, wet rock faces, permanent pools, roadside ditches and road-rut pools, ephemeral pools, and flood scours. Most habitats support multiple species and most species use both terrestrial and aquatic habitat types. Habitats that support relatively unique assemblages include emergent rocks and boulder fields, rock outcrops, first-order streams, wet rock faces, and ephemeral pools. Two state-listed species of concern were located including Wood Turtles (*Glyptemys insculpta*) in West Virginia (HAFE) and Timber Rattlesnakes (*Crotalus horridus*) in Maryland (CATO).

Each park in the National Capitol Region has unique habitats that afford protection for different species assemblage. In addition to protecting obvious habitats such as ephemeral pools used for amphibian breeding, other habitats should also be protected. The upland hardwood forest of CATO contains rock outcrops that provide den sites for Timber Rattlesnakes. The dry ridges of HAFE and CHOH parks are important lizard and snake habitats. Deep-water areas of the canals provide excellent habitat for turtles and aquatic and semi-aquatic snakes. The battlefield parks MANA and MONO provide open habitat important for snakes. The riparian areas in these parks are important habitats for some species of snakes. The more urban parks, WOTR, ROCR and GWMP, provide islands of natural habitats. Lantz Marsh in CATO and Dyke Marsh in GWMP are important wetland habitats for turtles and amphibians. Habitat protection in these

parks can be as simple as leaving woody debris in canals or along habitat edges as basking or cover objects. In addition, delaying maintenance of roadside ditches until after amphibian metamorphosis in summer will retain important breeding areas.

Although this study documented less than 90% of expected number of most species in the 8 parks, there are opportunities to add more species to the respective checklists. This can be accomplished by park staff taking digital photographs of road-kills and live specimens with appropriate documentation (date and location) appended to the digital image, and the use of natural history sighting cards filled out by park visitors. A herpetologist should confirm verification of new species.

Recommendations for parks within the National Capitol Region are presented in individual park reports. In general, inventories should be on going and the databases updated on an annual basis and comprehensive natural habitat management plans to conserve amphibians and reptiles should be developed in each park. Managers of rural parks should look to the conditions of the more urban parks to understand the potential value of conserving habitat within their park. Urban sprawl will continue to encroach the parks if the present trends continue.

ACKNOWLEDGMENTS

We acknowledge Tom Akre, John Blackburn, Will Brown, Vanessa Dozeman, Keith Johnson, George Middendorf, Seth Myers, Linh Phu, Jaime Sias, and Bill Sutton for their assistance in the field. We appreciate the professional advice from Marcus Koenen, Dianne Ingram, Robin Jung, and Ellen Gray. We thank the National Park Service for funding this project.

INTRODUCTION

(Modified From Mitchell 2005)

Over the past decade, the National Park Service has been working to establish what is now called the Inventory and Monitoring Program (I&M Program). The principal and simplified functions of this program are to gather existing as well as new information about the natural resources in the parks and to make that information easily available at different levels to park resource managers, the scientific community, and the public. Although some of the national parks in the United States have conducted field research on their existing flora and fauna (e.g., Braswell 1988; Pauley 1993; Mitchell and Anderson 1994; Hobson 1997, 1998; Forester 2000; Thompson 2000; Pauley et al. 2003), many parks have never completed baseline species inventories. Where information exists, it is often incomplete and inaccurate including species outside of their native range (Mitchell 2000a). For park managers to effectively maintain biological diversity and ecological health of their parks, they must have a basic knowledge of what natural resources exist in parks, as well as an understanding of those factors that may threaten them. One of the first goals of the I&M Program has been to establish baseline biological inventories for vascular plant and vertebrate species in order to provide reliable species lists, a fundamental tool for management.

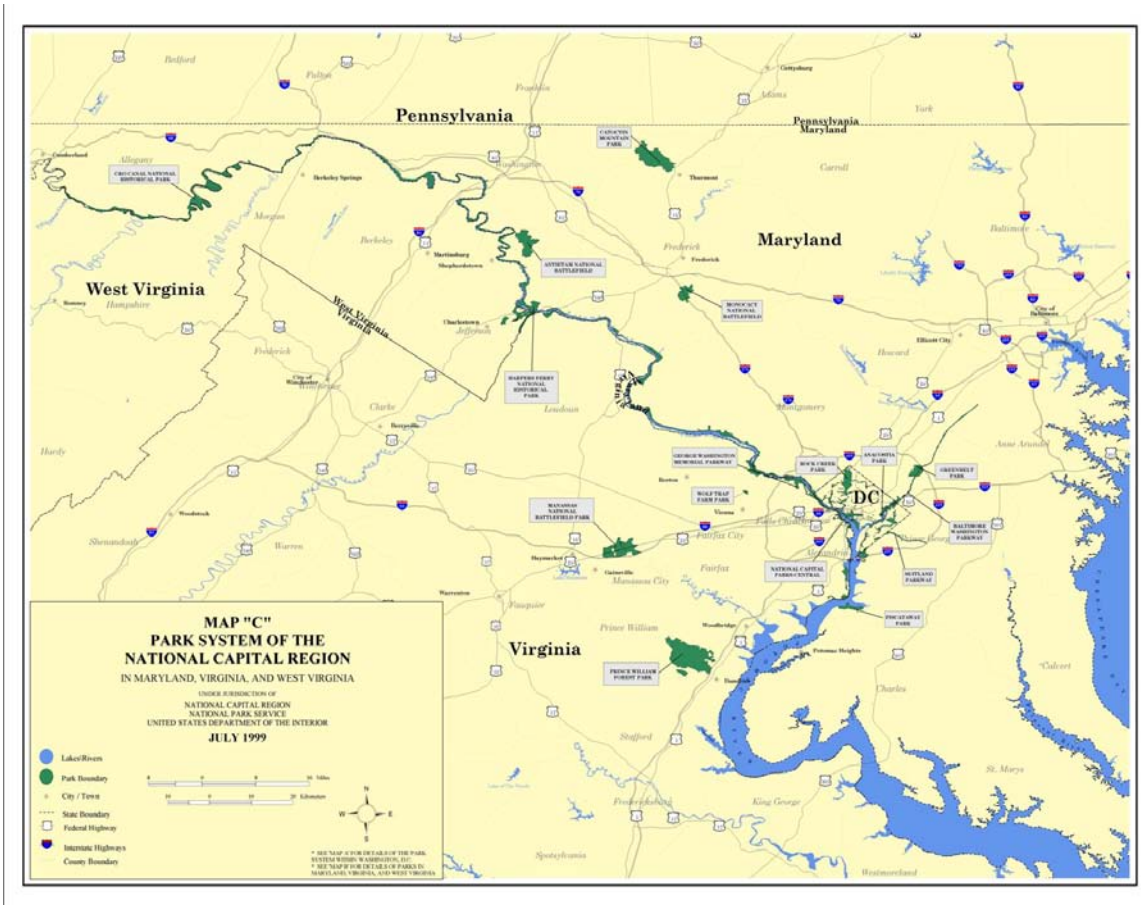
Beyond developing a documented species list, being able to associate species and their habitats within the parks is critical to planning and development of an effective land management strategy. Resource managers need credible information on species and habitat requirements to develop effective policies, guidelines and management recommendations. Inventories that include locality, species richness, and population information will provide a valuable spatial database for managers to use for a variety of habitat-specific or site-specific management needs.

STUDY AREAS

Inventories for amphibians and reptiles were conducted in all accessible habitats of each of the 8 parks in the National Capitol Region.

Locations of Herpetological Inventories:

Catoctin Mountain Park (CATO), George Washington Memorial Parkway (GWMP), Harpers Ferry National Historic Park (HAFE), Manassas Battlefield Park (MANA), Monocacy National Battlefield Park (MONO), Rock Creek Park (ROCR), and Wolf Trap Farm Park (WOTR). Only Reptile inventories were conducted in the Chesapeake and Ohio National Historic Park (CHOH).



METHODS

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach and standardize protocols to students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow investigators to target particular habitat types used by these species. Potential species were recorded if published distribution maps or species accounts overlapped the location of each park. A site reconnaissance was done on the initial visit and after council with park personnel we identified habitats for target species. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Ground searches were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects (Visual Encounter Surveys) (Heyer et al. 1994).

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data was recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. All animals were released alive at the site of capture or observation during this study.

Scientific and common names of amphibians and reptiles follow Crother (2000).

RESULTS AND DISCUSSION

Amphibians and reptiles are ectothermic animals, thus their activities are regulated by temperature and moisture regimes and this makes them seasonal in their activities. In order to complete a thorough inventory of amphibians and reptiles, it is incumbent on researchers to conduct field searches during all seasons and when temperature and precipitation conditions are optimal.

Amphibians are among the first animals that hibernate to emerge in the spring and, as a result, provide food for predators when other food sources are less available. Adult amphibians are secondary and tertiary consumers and larvae are primary consumers in forest and pond ecosystems (Dunson 1982). Predatory salamander larvae are important in determining abundance of zooplankton and aquatic insects (Dodson 1970; Dodson and Dodson 1971), and tadpoles are important in determining types and amounts of phytoplankton, magnitude of nutrient cycling, and levels of primary production (Seale 1980). Reptiles have epidermal scales and are somewhat less sensitive to moisture loss and toxic materials in the substrate than amphibians but their metabolism remains dependent on ambient temperatures.

Seventeen species of salamanders, 15 species of frogs, 10 species of turtles, 6 species of lizards, and 22 species of snakes could occur in the 8 parks in the National Capital Region based on published distribution maps (Kelly, et al. 1936; McCauley 1945; Wood 1954; Linzey and Clifford 1981; Tobey 1985; Green and Pauley 1987; Mitchell 1994; Conant and Collins 1998; Petranka 1998; Mitchell and Reay 1999). This study documented 25 species of amphibians and 25 species of reptiles. These include 14 species of salamanders (82% of expected species), 11 species of frogs (73% of expected species), 7 species of turtles (70% of expected species), 3 species of lizards (60% of expected species), and 15 species of snakes (68% of expected species). A comparison of the percentage of species documented per taxonomic group in each park is shown in Table 1. Most of the percentages are below the 90% goal of finding each potential species in individual parks. When species found are combined for all parks, percentages of species are higher, ranging from 50% for lizards to 82% for salamanders (overall average for all species is 71.5%).

The combined percentages represents at least a single occurrence of all species known to occur throughout the area covered by the 8 parks. Acreage and habitat types are limited in the 8 parks studied and therefore species diversity is limited. With the exception of CHOH (19,586 acres), sizes of parks range from 130 acres at WOTR to 7,210 at GWMP. The 2 largest parks, CHOH (19,586 acres) and GWMP (7,210 acres), are linear in shape following the C&O Canal and the George Washington Parkway. Habitats in the CHOH are for the most part limited to the towpath, canal, and narrow bottomlands along the canal. Habitats along the GWMP consist mainly of well-maintained landscapes. If the total area encompassed by all 8 parks is considered as a whole (Table 1), the percentage of species observed is much higher than in individual small parks.

Historical records of some species of amphibians and reptiles may no longer be valid given the habitat alterations that have occurred over the last 75 years in the Eastern United States. An example of this is CATO, where the comparison of studies of amphibians and reptiles by H. Charles Robertson in 1938 and by Michael R. Randolph in 1984 show the potential loss of some species within the 40 years between these 2 studies. Three species of salamanders observed by Robertson, Northern Dusky Salamanders (*Desmognathus fuscus*), Long-tailed Salamanders (*Eurycea longicauda*), and Northern Slimy Salamanders (*Plethodon glutinosus*) were not found by Randolph. In the current study reported here, we found Northern Slimy Salamanders and Northern Dusky Salamanders but not Long-tail Salamanders at CATO. Randolph found 2 species, Four-toed Salamanders (*Hemidactylium scutatum*) and Red-spotted Newts (*Notophthalmus v. viridescens*), which were not found in this current study. These studies illustrate the secretive nature of amphibians and reptiles and show that they are not always observed during time-limited studies.

It is obvious that habitats have been lost and altered throughout the eastern United States. Robertson conducted his studies during construction of the park and before it was open to the public. He commented on the “slaughter” of Black Ratsnakes by the workmen and how few stones had been left unturned. Randolph stated a concern about the loss of lentic habitats that could have supported aquatic species such as Four-toed Salamanders and Red-spotted Newts. Development and loss of habitats in other parks are

more likely than not to mirror what Robertson and Randolph reported. The result is that the small acreages of most of these 8 parks along with limited habitat diversity and destruction and alteration of habitats by developments have probably reduced the number of species that our potential lists indicate.

Table 2 shows a comparison of the percentage of amphibian (frogs and toads, salamanders) and reptile (turtles, lizards, and snakes) groups documented in each park from inventories in this study, literature, and the National Park Service database (Mitchell 2000a). When these 3 sources are combined, the percentage of species documented ranges from 40 to 100. These data show that many species have never been observed in the respective parks and it may be that these species are not present. It should be understood that amphibians and reptiles are very secretive and in some cases it may take years of searching with multiple techniques to document the presence of some species. Additional searches during favorable weather conditions may reveal more species. Many species of snakes are active only during favorable weather conditions, usually warm and wet periods (Wright and Wright 1957; Gibbons and Semlitsch 1987). Many snakes are particularly difficult to survey because they are secretive and not overly abundant (Gibbons et al. 1997). Lieden et al. (1999) showed that if multiple techniques are used 66% of the snake species expected to be present in a given area were captured in the first 75 days but to reach 90% of the species an additional 325 days were required. In studies by Whiteman et al. (1995) and Gibbons et al. (1995), it took over 22 years to discover one snake species on the Savannah River site, an area that had been intensively studied for over 40 years.

Geographic Distribution

Different assemblages of amphibians and reptiles were found in these 8 parks (Table 3). Most species were found at HAFE with 18 species of amphibians and 16 species of reptiles followed by MANA (15 amphibian and 17 reptile species), GWMP (14 amphibian and 17 reptile species), CHOH (14 amphibian and 15 reptile species), CATO (14 amphibian and 6 reptile species), MONO (9 amphibian and 9 reptile species), WOTR (10 amphibian and 6 reptile species), and ROCR (12 amphibian and 3 reptile species).

Sampling Success

Table 4 shows the number of individuals of each species documented at each park in relation to sampling methods used. The most successful or most often used method was the Visual Encounter Survey (VES) followed by traps (minnow and turtle traps) and auditory surveys (Heyer et al. 1994).

Amphibians and reptiles exist in a landscape environment (Semlitsch 2003) and it is, therefore, important that different habitat types exist for their survival in each of the 8 parks. To maintain a variety of habitats and the long-term preservation of animal assemblages, proper management and maintenance of the landscape by park personnel will be necessary. In this regard, maintenance or grounds keeping personnel are as important as biologists. Education and policy regarding herpetological species are needed at all levels and scope of work, especially those in close contact with the habitat.

A number of potential threats to species diversity or conservation are evident. Major threats or environmental concerns that must be addressed if long-term sustainability of species assemblages is to be achieved include habitat fragmentation, encroachment by suburban or urban areas, poor water quality, attrition of long-lived species, invasive exotic species, and introduction or release of captive or non-native species.

Habitat Fragmentation

Most amphibians and reptiles use multiple adjacent habitat types during daily and seasonal movements (Reinert 1993; Buhlmann 2001; Semlitsch 2003). Many species may travel one or more kilometers between foraging, nesting, or hibernation sites within one active season (Gregory et al. 1987; Semlitsch 1998; Semlitsch and Brodie 1998; Pauley et al. 2000). When a species is observed in a single habitat type this may not be indicative of the multiple habitats required for its survival. The study presented in this report was qualitative and was not designed to determine the full extent of habitat usage of the observed species. Further study would be needed to determine specific habitat usage for each park as the behavior and habitat requirements may change across the range of a widely distributed species. Some species of amphibians migrate *en mass* to breeding pools during their mating periods. Maintaining viable amphibian populations requires

knowledge of the terrestrial connections between breeding sites and foraging and hibernation sites. Semlitsch and Jensen (2001) demonstrated that to preserve amphibian populations it is necessary to maintain a core habitat of breeding pools and the terrestrial habitats as well as buffer zones around these habitats.

During amphibian migrations large numbers of animals can be killed on roads or highways. Limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population (Dodd et al. 1989; Ashley and Robinson 1996; Forman and Alexander 1998, Mitchell 1994, 2000b, 2002). Many small amphibian species cannot or will not cross roads, therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Forested areas with full or partial canopy and downed woody debris are important habitats for many species and should be maintained. These habitat "islands" are important microhabitats for several species of amphibians and reptiles. Opening forest canopies increases insolation and dries the forest floor, which leads to increased soil temperatures that reduce numbers of salamander species. Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997). Another important consideration concerning fragmentation is creating amphibian breeding habitat such that animals must cross roads. This may create a population sink that may kill more animals on roads than the potential breeding areas can produce.

Encroachment

Encroachment is habitat destruction due to anthropogenic disturbances such as housing or business developments that surrounds or isolates a park boundary. Encroachment is an extreme version of habitat fragmentation in that it irreversibly replaces natural habitats. If encroachment surrounds a park, island biogeography with its particular genetic phenomena will result. Islands typically have limited genetic diversity and large proportions of diversity can be lost due to founder or bottleneck effects. In addition to detrimental genetic consequences, human habitation supplements or subsidizes different groups of animals. Bird species such as Pigeons or European

Starlings and mammals such as Raccoons, Foxes, Skunks, White-tailed Deer and feral domestic cats are associated with humans and can influence other natural animal populations. For example, raccoons prey on turtles and their eggs and can reduce populations. This is especially important in areas where barriers such as roads, RR tracks or towpaths act as barriers that limit turtle nesting habitat. Predators follow the barrier and find the nests. Evidence of turtle nest predation was observed along CHOH towpath in several locations, such as just west of Oldtown, Maryland. Campgrounds or areas with garbage result in high densities of raccoons even in suburban areas such as the parks in the National Capital Region. White-tailed deer over browse native vegetation, which leads to proliferation of exotic species and to opening or removal of the understory. In addition to changing the understory and potentially decreasing moisture levels by increasing airflow on the forest floor, deer can trample ephemeral pools and create trails that can lead to erosion. Long-term habitat management at all parks would benefit all species known and potentially present in each park. Potential construction projects should be considered in a landscape context thereby protecting all habitats used by species.

Water Quality

Water quality is an important consideration for the Nations Capitol Parks. Two separate problems exist with water quality including water chemistry and water quantity. Water runoff from suburban and urban areas can be contaminated with pesticides, herbicides, fertilizers, heavy metals, sewage and other toxic substances. These pollutants can reduce species diversity, especially with amphibians. In addition to chemical pollutants, runoff from impervious surfaces can kill or displace amphibians in streams. High water volumes in small streams can kill, dismember and move both aquatic and terrestrial species of salamanders that inhabit riparian zones (Watson and Pauley, manuscript in preparation). High water in larger streams can inundate ephemeral pools used as breeding areas and displace egg masses or larvae.

Standing water, especially those areas utilized by amphibians should be maintained. Simple steps such as postponing roadside ditch maintenance until after the

breeding season or metaphoric period of young frogs and toads can help preserve amphibian populations.

Attrition

People and predatory mammals can also be detrimental to the status of some species of amphibians and reptiles. Garber and Burger (1995) found that in recreational areas complete Wood Turtle populations were lost by people removing turtles. People also frequently remove Box Turtles. Both turtle species are subject to heavy collecting by pet traders or curious park visitors. Snakes are often killed on sight regardless of species. Long-lived species such as salamanders and turtles often have low fecundancy and take a long time to reach sexual maturity, therefore removal of just a few individuals may impact the future. Careful evaluations should be conducted before areas of parks containing sensitive species are opened to public access.

Invasive Exotic Species

Invasive exotic species are a major problem facing management of all natural areas. This is an especially important problem given the importance of the Nations Capitol Region Parks in conserving habitat. Invasive plants and shrubs can displace native plants and have been shown to influence amphibian populations. The potential impact of the proliferation of exotic species can be catastrophic to species diversity as a few species of exotics can displace a wide diversity of native species.

Release of non-native species

Non-native species can become locally established when pet animals such as snakes, turtles, ducks or live non-native fish bait are released. Park personnel should be given training on the potential animal or plant species found in the parks. To conserve native species, non-native, exotic or species outside their normal distribution range should be collected and removed from parks and knowledgeable scientists consulted for positive identification and potential destruction or relocation out of natural habitats. Captive animals may harbor diseases that can be transmitted to natural populations.

Additional Inventory Work

With the possible exception of Spadefoots (*Scaphiopus holbrookii*), additional inventories to document species are not needed for toads and frogs in any of the parks. There is probably little need to conduct extensive searches for salamanders in most parks. Most likely candidates for documentation are Jefferson Salamanders (*Ambystoma maculatum*) and Red-spotted Newts (*Notophthalmus v. viridescens*) in CATO and Spotted Salamanders (*Ambystoma maculatum*) and Red-spotted Newts (*Notophthalmus v. viridescens*) in MONO. Documentation of turtles usually requires traps and therefore more labor intensive searches.

Several turtle species could potentially be found if intensive studies were conducted. Probable species are: Spotted Turtles (*Clemmys guttata*) and Eastern Box Turtle (*Terrapene c. carolina*) in CATO; Eastern Mud Turtles (*Kinosternon subrubrum*) in CHOH; Wood Turtles (*Glyptemys insculpta*) in MONO and GWMP; Eastern Snapping Turtles (*Chelydra s. serpentina*) and Eastern Painted Turtles (*Chrysemys p. picta*) in ROCR; and Eastern Snapping Turtles (*Chelydra s. serpentina*) in WOTR. Spotted Turtles (*Clemmys guttata*), and Northern Diamond-backed Terrapins (*Malaclemys t. terrapin*) were documented in the CHOH by Don Forster and Ed Thompson in 2000. Don Forester also found Red-eared Sliders (*Trachemys s. elegans*) in CHOH in 2000.

Lizards must be closely examined for proper identification. They are swift and agile and can easily elude capture during VES. With intense searches likely species yet to be documented include: Eastern Fence Lizards (*Sceloporus undulatus*) and Common Five-lined Skink (*Eumeces fasciatus*) in CATO; Broad-headed Skink (*Eumeces laticeps*), Eastern Six-lined Racerunner (*Aspidoscelis s. sexlineata*), Little Brown Skink (*Scincella lateralis*) in CHOH; Eastern Fence Lizards (*Sceloporus undulatus*) and Little Brown Skinks (*Scincella lateralis*) in GWMP; Common Five-lined Skinks (*Eumeces fasciatus*) in HAFE; Eastern Fence Lizards (*Sceloporus undulatus*) in MANA; Eastern Fence Lizards (*Sceloporus undulatus*) and Common Five-lined Skinks (*Eumeces fasciatus*) in MONO; Eastern Fence Lizards (*Sceloporus undulatus*), Common Five-lined Skink (*Eumeces fasciatus*) and Little Brown Skinks (*Scincella lateralis*) in ROCR; and Eastern Fence Lizards (*Sceloporus undulatus*) in WOTR.

More inventory work is needed to document additional species of snakes than any other reptile group. Snakes are secretive and many are only active during periods of optimal weather conditions. Studies during warm and wet periods (Wright and Wright 1957; Gibbons and Semlitsch 1987) could result in documentation of several species in most parks that were not found in this current study. Most likely species to be found are: Northern Black Racers (*Coluber c. constrictor*), Black Ratsnakes (*Elaphe obsoleta*), Eastern Milksnakes (*Lampropeltis t. triangulum*), Common Watersnakes (*Nerodia s. sipedon*), Queen Snakes (*Regina septemvittata*), and Northern Copperheads (*Agkistrodon contortrix mokasen*) in CATO; Eastern Wormsnakes (*Carphophis a. amoenus*), Northern Black Racers (*Coluber c. constrictor*), Eastern Milksnakes (*Lampropeltis t. triangulum*), Northern Rough Greensnakes (*Opheodrys a. aestivus*), and Queen Snakes (*Regina septemvittata*) in CHOH; Northern Rough Greensnakes (*Opheodrys a. aestivus*) in GWMP; Northern Black Racers (*Coluber c. constrictor*), Eastern Hog-nosed Snakes (*Heterodon platirhinos*) and Timber Rattlesnakes (*Crotalus horridus*) in HAFE; Eastern Milksnakes (*Lampropeltis t. triangulum*) in MANA; Northern Black Racers (*Coluber c. constrictor*) and Common Watersnakes (*Nerodia s. sipedon*) in MONO; Northern Black Racers (*Coluber c. constrictor*), Northern Ring-necked Snakes (*Diadophis punctatus edwardsii*), Eastern Milksnakes (*Lampropeltis t. triangulum*), Common Watersnakes (*Nerodia s. sipedon*), Eastern Gartersnakes (*Thamnophis s. sirtalis*) at ROCR; and Northern Black Racers (*Coluber c. constrictor*), Northern Ring-necked Snakes (*Diadophis punctatus edwardsii*), Black Ratsnakes (*Elaphe obsoleta*), Eastern Milksnakes (*Lampropeltis t. triangulum*); and Northern Rough Greensnakes (*Opheodrys a. aestivus*) in WOTR.

Additional documentation to increase amphibian and reptile species list could be accomplished by collecting digital photographs of road-kills with date and location and the use of amphibian and reptile natural history sighting cards filled out by knowledgeable visitors. Inventories by herpetologists targeting specific species could add to the documented species list in each park.

This report includes

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As the nation's principal conservation agency, the Department of the Interior has the resonsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environment and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-61 / September 2002 / Printed on recycled paper

★ U.S. GOVERNMENT PRINTING OFFICE: 2002—846-033

Table 1. Comparison of percentage of amphibian and reptile groups documented during inventories in each park with cumulative percentage of all parks.

Taxonomic Group	CATO	GWMP	HAFE	MANA	MONO	ROCR	WOTR	CHOH	CUMULATIVE
Frogs/Toads	73	69	64	92	50	42	55	40	73
Salamanders	54	55	79	40	27	50	40	53	82
Turtles	33	67	63	72	57	10	43	60	70
Lizards	0	50	50	40	33	0	25	40	60
Snakes	24	47	45	56	25	12	12	24	68

Table 2. Comparison of percentage of amphibian and reptile groups documented per park through inventories in this current study and these inventory data combined with data from literature and National Park Service database (Literature and NPSpecies from Mitchell 2000).

Parks	**Inventory**	**Combination**
Frogs and toads		
CATO	73	82
CHOH	40	80
GWMP	69	85
HAFE	64	73
MANA	92	100
MONO	50	80
ROCR	42	59
WOTR	55	82
Salamanders		
CATO	54	92
CHOH	53	93
GWMP	55	73
HAFE	79	79
MANA	40	50
MONO	27	91
ROCR	50	83
WOTR	40	70
Turtles		
CATO	33	83
CHOH	60	100
GWMP	63	100
HAFE	67	63
MANA	72	72
MONO	57	57
ROCR	10	50
WOTR	43	58
Lizards		
CATO	0	67
CHOH	40	60
GWMP	50	100
HAFE	50	75
MANA	40	40
MONO	33	67
ROCR	0	50
WOTR	25	50

Parks	Inventory	Combination
Snakes		
CATO	24	71
CHOH	24	76
GWMP	47	75
HAFE	45	61
MANA	56	56
MONO	25	81
ROCR	12	77
WOTR	12	53

Table 3. Checklist of the amphibians and reptiles observed in 8 parks in the National Capital Region

Scientific Name	Common Name	CATO	CHOH	GWMP	HAFE	MANA	MONO	ROCR	WOTR
FROGS									
Acris c. crepitans	Eastern Cricket Frog					X			
Bufo a. americanus	Eastern American Toad	X	X	X	X	X	X	X	X
Bufo fowleri	Fowler's Toad	X		X	X	X			
Hyla chrysoscelis	Cope's Gray Treefrog			X		X		X	X
Hyla versicolor	Eastern Gray Treefrog	X	X			X			
Pseudacris c. crucifer	Northern Spring Peeper	X		X	X	X	X	X	X
Pseudacris f. feriarum	Upland Chorus Frog					X			
Rana catesbeiana	American Bullfrog	X	X	X	X	X	X	X	
Rana c. melanota	Northern Green Frog	X	X	X	X	X	X	X	X
Rana palustris	Pickerel Frog	X	X	X	X	X	X		X
Rana sylvatica	Wood Frog	X	X	X	X	X	X	X	X
SALAMANDERS									
Ambystoma jeffersonianum	Jefferson Salamander		X		X				
Ambystoma maculatum	Spotted Salamander	X	X	X	X	X		X	X

Ambystoma opacum	Marbled Salamander		X					X	
Desmognathus fuscus	Northern Dusky Salamander			X	X			X	
Desmognathus monticola	Seal Salamander				X				
Eurycea bislineata	Northern Two-lined Salamander	X	X	X	X	X	X	X	X
Eurycea l. longicauda	Long-tailed Salamander		X		X				
Gyrinophilus p. porphyriticus	Northern Spring Salamander	X			X			X	
Hemidactylium scutatum	Four-toed Salamander			X					
Notophthalmus v. viridescens	Red-spotted Newt, Red Eft		X	X	X	X			X
Plethodon cinereus	Eastern Red-backed Salamander	X	X	X	X	X	X	X	X
Plethodon glutinosus	Northern Slimy Salamander	X					X		
Plethodon hoffmani	Valley and Ridge Salamander		X		X				
Pseudotriton r. ruber	Northern Red Salamander	X			X				
TURTLES									
Chelydra s. serpentina	Eastern Snapping Turtle	X	X	X	X	X	X		
Chrysemys p. picta	Eastern Painted Turtle		X	X	X	X	X		X
Glyptemys insculpta	Wood Turtle	X	X		X				

Pseudemys rubriventris	Northern Red-bellied Cooter		X	X	X				X
Sternotherus odoratus	Stinkpot		X	X	X	X			
Terrapene c. carolina	Eastern Box Turtle		X	X	X	X	X	X	X
Trachemys s. elegans	Red-eared Slider			X		X	X		
LIZARDS									
Eumeces fasciatus	Common Five-lined		X	X		X			X
Eumeces laticeps	Broad-headed Skink			X	X	X	X		
Sceloporus undulatus	Eastern Fence-Lizard		X		X				
SNAKES									
Agkistrodon c. mokasen	Northern Copperhead		X	X	X	X			
Carphophis a. amoenus	Eastern Wormsnake			X	X	X		X	X
Coluber c. constrictor	Northern Black Racer			X		X			
Crotalus horridus	Timber Rattlesnake	X	X						
Diadophis p. edwardsii	Northern Ring-necked Snake	X	X	X	X	X	X		
Elaphe o. obsoleta	Black Ratsnake		X	X	X	X	X	X	
Heterodon platirhinos	Eastern Hog-nosed Snake					X			
Lampropeltis c. rhombomaculata	Mole Kingsnake			X		X			

Lampropeltis t. triangulum	Eastern Milksnake			X	X		X		
Nerodia s. sipedon	Common Watersnake		X	X	X	X			X
Opheodrys a. aestivus	Northern Rough Greensnake				X				
*Storeria d. dekay*i	Northern Brownsnake					X			
Storeria o. occipitomaculata	Northern Red-bellied Snake	X							
Thamnophis s. sauritus	Common Ribbonsnake		X						
Thamnophis s. sirtalis	Eastern Gartersnake	X	X	X	X	X	X		

Table 4. Number of each species of amphibian and reptile documented by sampling method in National Capitol Region Parks

	Auditory Surveys	Dip Net Survey	Minnow Traps	Turtle Traps	Visual Encounter Survey
Toads					
Bufo a. americanus	7	1			294
Bufo fowleri	1				12
Frogs					
Acris c. crepitans	3				3
Hyla chrysoscelis	6	383			16
Hyla versicolor	2				3
Pseudacris brachyphona	1				
Pseudacris c. crucifer	9	2			20
Pseudacris f. feriarum	1				32
Rana c. melanota	7	2	2		39
Rana catesbeiana	6	2	2	3	14
Rana palustris	3	3			18
Rana sylvatica	3	1	50		43
Salamanders					
Ambystoma jeffersonianum		1			1
Ambystoma maculatum		97			67
Ambystoma opacum					1
Desmognathus fuscus					52
Desmognathus monticola					1
Eurycea bislineata		9			66
Eurycea longicauda					5
Gyrinophilus p. porphyriticus		6			3
Hemidactylium scutatum					2
Notophthalmus v. viridescens		2			11
Plethodon cinereus		2			146
Plethodon glutinosus					13
Plethodon hoffmani					3
Pseudotriton r. ruber		1			1
Turtles					
Chelydra s. serpentina				14	26
Chrysemys p. marginata					2
Chrysemys p. picta				152	102
Glyptemys insculpta					7
Pseudemys rubriventris					23
Sternotherus odoratus				2	2
Terrapene c. carolina					48
Trachemys s. elegans				5	5
Lizards					
Eumeces fasciatus					12
Eumeces laticeps					11
Sceloporus undulatus					7

	Auditory Surveys	Dip Net Survey	Minnow Traps	Turtle Traps	Visual Encounter Survey
Snakes					
Agkistrodon c. mokasen					10
Carphophis a. amoenus					13
Coluber c. constrictor					50
Crotalus horridus					2
Diadophis p. edwardsii					50
Elaphe o. obsoleta					33
Heterodon platirhinos					2
Lampropeltis c. rhombomaculata					4
Lampropeltis t. triangulum					7
Nerodia s. sipedon				1	24
Opheodrys a. aestivus					1
Storeria d. dekayi					1
Storeria o. occipitomaculata					1
Thamnophis s. sauritus					1
Thamnophis s. sirtalis					24

APPENDIX 1

Inventory Methods Handbook

National Park Service Capitol Regions

Authors: Mark B. Watson, Thomas K. Pauley, and Joseph C. Mitchell
Date: January 2002

INTRODUCTION

This document contains protocols to be used for herpetological inventories in National Park Service Parks in the National Capitol Region. Protocols will describe collection and reporting of data in order to satisfy terms of the contract.

In general, our contract states that we will:

1. Identify important habitat based on available resources.
2. Obtain pertinent permits.
3. Use time-constrained searches for amphibians and reptiles.
4. Search aquatic habitats for frogs and salamanders,
5. Sample for turtles using large and small hoop traps and spotting scopes.
6. Document potential habitat for state and federal species of concern. Attempt all collection methodologies to determine the presence or absence of these rare species.
7. Document data on standardized field sheets.
8. Collect voucher specimens or photographs for all species. Where possible, individuals found dead will be used as vouchers. Rare, threatened and endangered species will not be sacrificed as voucher specimens.
9. Prepare a written final report of the findings and recommendations and present them to the NPS in a seminar
10. Cooperate with the NPS regarding protected information about sensitive resources including locations of rare, threatened, and endangered species in the NCR parks.

Inventory philosophy:
The mission of our contract is to conduct herpetological inventories of selected parks in the National Capitol Region. As such, our goal is to identify at least 90% of the amphibian and reptile species found within each park. Therefore, it is important to search in as wide a variety of habitats as are found in each park. Efficiency will be paramount in covering all areas. Additional time may be spent gathering morphometric data; in so much as it does not interfere with the primary objective. Morphometric data will help provide information about population structures within the parks and when combined with the inventory information will enhance the usefulness of the final product to park managers. Given the magnitude of our task and limited funds, most sites will only be

examined once. We will not attempt to monitor sites, that is, visit sites repeatedly to collect environmental data (air temperature, soil temperature, etc.) and biological data (reproductive status of species over time, etc.). If there are repeated visits to an area, this will be done at difference seasons in an attempt to not miss a species that may be present.

General:
Preparedness is one of the most important aspects of efficient collecting. In addition to the standard environmental instruments, compass and GPS unit etc, every team member should have a timepiece, writing utensil, data sheets, and topographical maps. See Appendix 1 for detailed lists of equipment. Since we be in public parks we should be dressed professionally.

Standard Protocols

Procedure:
Inventory search parameters:

* Before starting the search! All environmental and positional data should be recorded onto data sheets and start time noted.

* Each search should last 1-person hour per site.

For example: a) If two people are conducting inventories the area should be searched for 30 minutes. b) If an animal is randomly encountered, such as hopping across the road or basking, then a data sheet should be rendered and 30 minutes should be spent searching the area for additional animals or this should be recorded as a haphazard search.

After 1-person hour has elapsed, a new site should be established along with a new data sheet. Searches uncovering no animals are equally as important as those that do.

* Searching should be as thorough as possible and should be done in order to document all species found in that habitat.

Search sites should contain only one habitat type; adjacent habitat types should be assigned a new number and searched accordingly.

If two people are searching, captured animals should be held in clean plastic bags containing moist soil substrate until completion of the search. After completion, animals should be measured and released at the site of capture. Bags should be discarded after each site. If three people are searching, the third person should record data and measure animals and this persons time should not be counted as collecting.

Data Collection
All data should be entered onto standardized data sheets. Data sheets will have spaces to record all data collected, as well as, reminders of what measurements should be taken for each species.

Glossary:

Search sites will be categorized into three types depending on the circumstances:
Inventories: Planned time-constrained searches of a particular habitat used to estimate relative surface abundance. Requires all positional and environmental fields be filled.
Habitat: Notes on habitat types that are useful to managers such as springs, wetlands, outcrops, etc. Requires only positional information and notes on potential species.
Haphazard: when an animal in encountered when not in a timed-inventory search, such as a road kill. Requires all positional and environmental fields be filled. This includes general haphazard searching of habitat patches.
Trap: When a trap is used to capture an animal in the absence of a person.

Site number:

The site number field will be filled by the data entry technician. This is the unique identifier for each location.

Date:

This is the date that the inventory was conducted: Format is: Month / Day / Year. Spell out month. Do not use 06/07/02, for example.

Quad:

This is the USGS 7.5 minute quadrangle where the site is located.

Location:

The location of the site should include general directions or bearing and distance from a prominent landmark (viz. stream, junction of two highways, etc.), such that the reader could return to the approximate location.

Elevation:

Elevation is the distance above sea level as determined by topographical map, GPS or altimeter. Units should be given in feet.

Aspect:

Aspect is measured using a compass while facing down the fall line of a slope. This determined as if the slope had eyes and you were deciding which direction it is looking. These should be given in major ordinal directions such as North, Northeast, Northwest etc.

Time

Time is given in 24:00 hour units and is to be given for the start of a search. As each search is for one-person hour, the ending time will be determined from the number of people searching (listed below).

Number of People:

This is the actual number of people involved in turning and searching, not including any onlookers or note-takers.

GPS:

Global coordinates for the center of each search site or the location of each habitat or haphazard event should be given. The park service is now requiring the use of GPS units and all spatial references be submitted in UTM coordinates, NAD 83. Please include the UTM zone on the datasheet.

UTM zones occur at every 6° of longitude. Below are the boundaries of UTM zones for the U.S. (Corpscon v 6)

LONGITUDE	ZONE
72 W to 66 W	19
78 W to 72 W	18
84 W to 78 W	17
90 W to 84 W	16
96 W to 90 W	15
102 W to 96 W	14
108 W to 102 W	13
114 W to 108 W	12
120 W to 114 W	11
126 W to 120 W	10
132 W to 126 W	9
138 W to 132 W	8
144 W to 138 W	7
150 W to 144 W	6
156 W to 150 W	5
162 W to 156 W	4
168 W to 162 W	3

Macro-habitat Type:

To facilitate comparisons between parks, habitats have been predefined into the following generalized categories. Each of these habitat types may support a unique herpetofauna.

Terrestrial habitat types

Road Cuts. These habitats are created when road construction removed a portion of a hillside. They are often open, dry, sunny areas with plentiful rocks and other cover objects that are ideal snake and lizard habitats.

Rock Piles. Rock piles are usually waste rocks discarded from road building or other construction. Rock piles are usually very open sunny areas that provide cover for snakes and lizards.

Riparian Floodplains. Riparian floodplains are areas along the rivers or smaller streams (viz, first-order streams) that are periodically inundated with water. These areas consist of open, rocky or sandy substrates with little organic matter or soil (Pauley et al. 2000). They often contain numerous small pools. Vegetation in these habitats can include species such as buttonbush (*Cephalanthus occidentalis*), St. John's Wort (*Hypericum* sp.), river birch (*Betula lenta*), and sycamore (*Platanus occidentalis*).

Railroad Tunnels. Dark, cool and often moist conditions found within these tunnels are conducive to some amphibian species. Animals can be found in crevices in the tunnel wall or in ditches along the road or tracks through the tunnel.

Emergent Rocks or Boulder Fields. Emergent rocks resulted from erosion of the soil exposing underlying rocks. These rocks are usually surrounded by forest. Characteristic vegetation includes Christmas ferns (*Polystichum acrostichoides*), spinulous shield fern (*Dryopteris spinulosa*), Virginia creeper (*Parthenocisus quinquefolia*). This habitat type is provides important habitat for the green salamander, *Aneides aeneus* (Gordon and Smith 1949).

Rock Outcrops. Outcrops are large exposed areas of bare rock formed by the erosive forces of wind and water. Rock outcrops provide excellent habitat for many species of reptiles and amphibians including the green salamander (Gordon and Smith 1949).

Trails / Roads and Banks. Roads open the forest canopy resulting in dry habitats that can support thermophilic reptiles. They are often associated with other habitat types such as roadside ditches, road cuts, and wet rock faces.

Forests.

Old Fields and Rights-of-Way. These areas consist of power line rights-of-way, abandoned farmland, or other areas maintained or occurring at an early stage of succession. These areas are often sunny, warm and dry and are good reptile habitats. Areas strip-mined in the past are also placed in this category. Dominant vegetation in these habitats often included goldenrods (*Solidago* sp.), asters (*Aster* sp.), brambles (*Rubus sp.*) and multiflora rose (*Rosa multiflora*).

AQUATIC HABITAT TYPES

Third-order Streams. Third –order streams are formed by the confluence of two second-order streams and are characterized by perennial flow and usually contain fish (Pauley et al. 2000).

Second-order Streams. Second-order streams are formed by the confluence of two first-order streams and provide important habitat for numerous lungless salamanders and semi-aquatic snakes. These streams are mostly perennial and may contain few fish.

First-order Streams/Intermittent Streams. These mostly unnamed streams are important salamander habitats. (A stream may be considered intermittent if it is shown as such on the topographic map, although these designations are meaningless in reality.) These streams normally dry by the end of the summer and are usually small. They are still very important habitats for salamanders such as those in the genus *Desmognathus*.

Rivers. Rivers provide habitat for semi-aquatic snake species and turtle species.

Springs/Seeps. A spring or seep is where a small shallow stream emerges from the ground. These habitats are often rich in mosses and herbaceous plants and provide excellent breeding habitat for a large number of salamander species (Pauley et al. 2000).

Wet Rock Faces. These are exposed rock faces, either natural or man-made that are associated with springs or other water sources that run down the surface. This habitat type can support large populations of semi-aquatic salamanders (Huheey and Brandon 1973).

Permanent Pools. This refers to lentic bodies of water that do not dry during the summer, such as beaver ponds. These small pools, particularly if fishless, are important in maintaining populations of some amphibian species such as mole salamanders (Ambystomatidae) and some frog species (Mitchell et al. 1997).

Roadside Ditches and Road-rut Pools. These are the most numerous lentic aquatic habitat types in many areas. These puddles form either in road ruts or along the sides of roads due to the physical barriers roads present to the drainage of water. Roadside puddles range from ephemeral puddles to permanent pools with aquatic vegetation. They provide breeding habitat for a number of frog and toad species, especially *Pseudacris* sp. as well as a number of lungless and mole salamanders.

Ephemeral (Vernal) Pools. A pool is considered ephemeral if it is usually dry by the end of the summer. These pools, although temporary, are very important in maintaining metapopulations of many woodland amphibians (Pauley et al. 2000).

Flood Scours. Flood scour depressions are pools formed in the riparian zone due to the erosive qualities of a river during high water events. These scours resemble oxbows in many respects and present potential habitat for some frog species and turtles.

Micro-habitat types:

Microhabitat refers to the specific cover object or location where an animal is found. Examples are under rocks, logs, leaf litter, on gravel roads, in trees, etc.

Potential Species:

This field is used when reporting a habitat and should be used to speculate on what species may use this habitat. This is particularly useful when planning subsequent trips to an area.

Sample technique:

This field describes how the animal was captured: by hand, minnow trap, hoop trap, d-frame net, etc.

Morphometric Data

Morphometric data include measurements of animals that are diagnostic to their life history and can give insight into the health or population structure within a habitat. The distinct shapes exhibited by the herpetofauna dictate that each group be measured differently. Other useful data include the sex and life stage.

The name of each individual should be reported as the genus, species and subspecies where appropriate. Non-ambiguous abbreviations or common names may be substituted for common species. These will be translated into the scientific nomenclature by the data entry technician.

Sex determination

Salamanders:

The sex of salamanders is determined by the secondary sex characteristics exhibited by individuals during the breeding season or those retained throughout the year.

Plethodon

The small *Plethodon* species, such as *P. cinereus*, are sexed based upon snout and vent morphology. Males tend to have squared snouts and an enlarged or swollen cloacal vent, whereas females have rounded snouts and the cloacal vent is not swollen.

The large *Plethodon* species, such as *P. glutinosus* or *P. wehrlei*, are sexed based upon the presence of a mental hedonic gland found on the lower chin of males. This gland may be absent during certain times of the year, but when found is diagnostic.

Desmognathus

Members of the Genus *Desmognathus* are sexed based upon hedonic glands found on the lower jaw of adult males. In several species the cloaca of males has a papillose lining and the females lack this lining. A 10X hand lens may be required to view these glands

Eurycea

Males of the Genus *Eurycea* tend to develop large squared heads and prominent cirri

Aneides

Males of *Aneides* have a relatively prominent mental hedonic gland.

Hemidactylium

Males of the genus *Hemidactylium* can be distinguished by the presence of cirri and the large squared snouts. *Hemidactylium* males tend to be slightly smaller than females.

Gyrinophilus

In adult males the inner walls of the cloaca has different papillae than the females. The translucent abdomen also allows for the examination for the presence of follicles or eggs in the female. Often this is aided by the use of a flashlight.

Ambystomids

Male typically have swollen bulb shaped cloaca, where the females have smaller cloaca. The Marbled salamander, *A. opacum*, male has silvery white bands and the female has grayish bands.

Newts

Male newts tend to exhibit swollen cloacal vent and rows of spots on the inside of the hind legs. Females have an oval-shaped cloacal vent.

Frogs and Toads:

Many species of male frogs exhibit swollen thumbs during the breeding season. Males of the species are often heard calling and can be identified as such if captured in the act of calling. Male frogs often tend to have darkened patches on the underside of the chin corresponding to the vocal sacs during the breeding season.
The tympanic membrane of male green frogs is typically larger than the eye.

Lizards:

Male lizards can usually be distinguished by their brightly colored markings, which are often bright blue along the throat. In *Sceloporus*, females and young have distinct wavy crossbands. The males have less distinct crossbands. In *Eumeces,* males have reddish heads in breeding season.

Snakes:

The hemipenes of many male snakes can be exposed by gentle pressure on the proximal end of the tail towards the cloaca. The base of the tail in males is wider than in females.

Turtles:

Box and Wood turtles can be sexed by the presence of a concave plastron on male turtles; some male box turtles may have orange or red eyes, legs and necks.

Most Emydid turtles are sexually dimorphic with males having long fore claws and the cloaca usually extends past the carapace when gentle pressure is applied to stretch the tail.

Musk turtles are distinguished by males showing a pronounced fleshy mid plastral joint. The female turtles exhibit only small amounts of fleshy material between the plastral scutes. The cloacal opening is beyond the carapace in males.

Softshell turtles can be sexed by observing the cloaca. Male softshells tend to be smaller and the cloaca extends past the posterior margin of the carapace. Female softshells tend to have a camouflage pattern to the carapace whereas males tend to show small ring-like markings.

Common snapping turtles are the most difficult of the turtles, since they do not exhibit striking sexual dimorphisms. One method is to insert your small finger into the cloaca to feel for a penis.

Life Stage
Life stage refers to the developmental age of the animal in question. Usual stages are egg, larvae/tadpole, metamorph, juvenile, subadult, and adult.

The egg stage is self-explanatory. Larvae or tadpole stage refers to the aquatic/gilled stages of salamanders and tadpole refers to the aquatic stages of frogs and toads before metamorphosis**.** Metamorphs are individuals that have just lost their gills / tails and are leaving the water. Remnants of the tail or buds of the gills may still be present at this stage. Juvenile refers to the stage after metamorphism, where adult features may not be present. Subadult refers to the stage preceding sexual maturity. Subadults are usually not of adult size and do not display secondary sex characteristics. Adult stage refers to animals of sexual maturity that may also display secondary sex traits, such as swollen thumbs in male frogs and toads, elongated front claws in male Emydid turtles.

Morphometrics
The following section describes how to measure all groups of amphibians and reptiles for this study.

Salamanders

Snout-Vent-Length (SVL)

Captured salamanders are to be placed in a measuring box or plastic bag at the users discretion. Salamanders should be pressed down to bottom corner of box or bag with

gentle pressure. Snout-to-vent length is measured using a dial caliper placing one face of the caliper at the tip of the snout and the other face of the caliper at the posterior end of the cloaca (The cloaca belongs to the body).

Tail Length (TL)

Tail length is measured from the posterior end of the cloaca to the tip of the tail. In case of regenerated tail, the number should be reported in the following format: original tail length + regenerated tail length

Mass

Mass is determined by placing the salamander in a small snack-sized plastic bag and attaching a spring balance (Pescola) scale. Mass is recorded as grams by subtracting the weight of the plastic bag from the weight of the salamander. You may also tare the scale with the bag.

Cranial Width (CW)

Cranial width is measured using dial calipers as the widest portion of the skull and is reported as millimeters. The widest point is usually at the back of the jaws.

Lizards and skinks

Fence lizards and skinks are measured as described for salamanders.

Snakes

Snout-Vent-Length (SVL)

Small snakes can be measured gently holding close to the head until the snake relaxes or gentle pressure can be applied to the tail. Large snakes can be stretched along a supportive surface such as a collecting rake or ground. A snake restraining tube can also be used. Snout-to-vent length is measured using tape measure placing one face of the tape at the tip of the snout and the end at the posterior end of the cloaca (The cloaca belongs to the body)

Tail Length (TL)

Tail length is measured from the posterior end of the cloaca to the tip of the tail. Tail deformities should be noted under the notes section. Take note of tail breaks.

Mass

Mass is determined by placing the snake in a plastic or cloth bag and attaching a spring balance (Pescola) scale. Mass is recorded as grams by subtracting the weight of the bag from the weight of the snake.

Cranial Width (CW)

Cranial width is measured using dial calipers as the widest portion at the base of the jaw and is reported as millimeters.

Turtles

Turtles are usually measured in one of two ways: midline and maximum distance. Turtles in this study should be measured both ways (at least in WV). 1) midline, which is notch to notch on the carapace. This measurement seems less variable due to differences in individual abnormalities in the marginal scutes. 2) maximum length -- this follows a straight line that gives the maximum length of the carapace. This is the standard measurement used by most turtle ecologists.

Seven measurements are taken on turtles: carapace length (CL), carapace width (CW), plastron length (PW), plastron width (PW), Depth or dorso-ventral distance, length of longest fore claw and precloacal distance. These measurements help determine size class and sex of the turtle.

Eggs

Frog and salamander egg masses should be counted. The number of eggs in each mass can be estimated if possible. The presence of spermatophores should also be noted.

"Hard-shelled" eggs should be counted and each egg measured for length, width and mass. Eggs should be returned to the nest and cover replaced as close as possible to how they were found.

Larvae

Larvae of many species tend to be locally abundant in breeding ponds; representative samples of about 10 individuals of each species (if possible**)** may be measured for total length and tail length. More importantly, our goal is to identify each making certain that all species are recorded.

Observational Data or Notes:
Space is available on the datasheet for field observations under "Notes" as well as on the back of the sheet. Important observations to note include: behavior of the animal, such as nesting, basking, feeding, egg laying, mating, calling, and dancing. Other observations would include odd phenotypes, such as deformities/malformations, aggregations, color

morphs or anything else that strikes as odd, such as finding the animal in an unusual habitat. Take photographs of all oddities and keep them for evaluation.

Additional notes should also be added pertaining to key habitats that may be important for managers, such as road-rut ponds, trails or roads impacting wetlands or access to breeding sites, and presence of beaver ponds.

Vouchers

Each park would like proof of each animal species found within its borders. This proof shall be given as photographs of each species. Photographs should be high enough in quality to discern distinguishing characters, such that positive identification can be made from photos. Therefore, a dorsal, ventral, side and head view of the animal as well as close-ups of key characteristics should also be taken. This picture should be cross-referenced to the data sheet when the animal was captured. It should also be noted on the data sheets that photos were taken of this animal. A photo of the habitat where this animal was found should also be taken. Use 400 ASA 35 mm film or digital camera. Take many pictures.

Venomous Snakes

– Observe only. Do not catch.

APPENDIX 2

REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

CATOCTIN MOUNTAIN PARK

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Introduction

Catoctin Mountain Park (CATO), located in the Blue Ridge Providence, is comprised of over 5,800 acres. Approximately 95% of the park is a mixed hardwood forest. The forest was extensively logged in the early 20th century.

Drs. Thomas K. Pauley and Mark B. Watson and graduate students from the Department of Biological Sciences at Marshall University, Huntington, WV conducted inventories.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to train students and other personnel associated with the study, an overview of the methods will be presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if distribution maps or accounts overlapped the location of CATO (Kelly et al. 1936; McCauley 1945; Conant and Collins 1998; Ernst et al. 1994; Petranka 1998). A site reconnaissance was done on the initial visit and after council with CATO personnel we identified habitats for target species. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. For example, spotted turtles are generally found in habitats that contain permanent shallow wetlands. If such habitats were not located, Spotted Turtles were removed from the potential species list. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data were recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of CATO and whose habitats were located by field reconnaissance are listed in Table 1. Fifty species had distributions that

overlapped the boundaries of CATO. The list of potential species is a conservative list used to guide investigation in this study and future studies

Species Summary

A summary of species observed during field inventories of CATO are listed in Table 2. Seven species of salamanders, 2 species of toads, 6 species of frogs, 2 species of turtles, and 4 species of snakes were observed. A number of potential species were not observed and, for the most part, their occurrence in the park cannot be ruled out. Several of these species are rare even in optimum habitats and others are very secretive or fossorial and may take several years using specialized inventory techniques, such as drift fences combined with pitfall traps, to identify their presence.

Table 3 compares the number of potential species with the number of species found for each group. Many species that were unaccounted for were species where CATO was located on the edge of their geographic distribution or habitat within the Park was marginal.

Habitats

Figure 1 shows the distribution of habitats where animals were observed. Mixed deciduous forests are the most common habitat type in the park. Forests are a mixture of mesic hardwoods in the ravines and valleys and more xerophytic hardwoods on the ridges. The major understory species included various Ericaceous shrubs. The forested habitats of the park are typical habitat for many woodland salamander species. The forests and aquatic habitats showed the highest number of species.

The floodplain of Owens Creek contained few amphibian and reptile species. A series of small-forested palustrine wetlands were located west of Park Central Road between the Visitor Center and Charcoal Trail. Lantz Marsh provided habitat for turtles and frogs. Small intermittent streams draining the park are also important habitat for plethodontid salamander species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. A diversity of salamander species from two taxonomic families was found at CATO; one

species of the Ambystomatidae, and 6 species of Plethodontidae. Ambystomatidae or mole salamanders were observed as larvae. One species of *Ambystoma* that was not observed was the Jefferson Salamander (*Ambystoma jeffersonianum*). Jefferson Salamanders may be overlooked because they are patchy in distribution, and they are a secretive fossorial species that breeds in the very early spring. Their larvae persist through the spring and mid-summer and are often found in the same pools as other Ambystomatid species. Although suitable habitat was observed within the park, extensive dipnet surveys found no Jefferson Salamander larvae. It should be noted that previous studies at CATO also did not report this species (Robertson 1938; Randolph 1984).

The most diverse group of salamanders observed was plethodontids (lungless salamanders). This family can be roughly divided into 2 groups, woodland salamanders and stream salamanders, based on habitat use. Two species of woodland salamanders, Eastern Red-backed Salamander (*Plethodon cinereus*) and Northern Slimy Salamander (*P. glutinosus*), were observed. Two color morphs of Red-backed Salamanders, the "red-backed" morph and "lead-backed" morph, were found. The "lead-backed" morph lacks most of dorsal red stripe characteristic of the "red-backed" morph. The lead-back phase is locally abundant and was the prevalent morph on Catoctin Mountain in the region of the Charcoal Trail. Woodland salamander habitat is found throughout the park.

Three species of stream-associated salamanders were found in small fishless streams. Such streams are excellent habitat for many species of salamanders. Northern Dusky Salamanders (*Desmognathus fuscus*), Northern Two-lined Salamanders (*Eurycea bislineata*) and Northern Spring Salamanders (*Gyrinophilus porphyriticus*) were found in 1st order streams. Most shaded clean streams in the park and surrounding area should support these salamanders. The stream salamanders and their larvae are the top predators in these fishless streams. Long-tailed Salamanders (*Eurycea longicauda*) are associated with streams but they were not found, although their distribution overlaps that of the park. Long-tailed Salamanders often inhabit riparian areas and hillsides adjacent to water. This species is often less abundant than Two-lined Salamanders (*E. bislineata*) and may be less tolerant of pollution or disturbances. Habitat for this species is similar to that of Long-tailed Salamanders. The ranges of two wetland salamander species,

Pseudotriton ruber (Northern Red Salamander) and *Hemidactylium scutatum* (Four-toed Salamander), are within CATO. Both species can be found along the edges of wetlands where they forage or deposit eggs. Northern Red Salamanders also inhabit 1st order streams. Northern Red Salamanders were located in the forested wetland west of Park Central Road. No Four-toed Salamanders were located during this current study, but M. R. Randolph found them in 1984. Female Four-toed Salamanders tend their clutch of eggs for about 2 months and can often be located at the edge of wetlands under vegetation or mosses. Habitat for this species is found in the spring seeps throughout the park and the larger wetlands such as Lantz Marsh and the smaller woodland wetlands located north of the Visitor Center.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. The majority of frog species observed were associated with the abandoned sewage lagoon/pond located adjacent to Round Meadow and the wetlands associated with Lantz Marsh. The Round Meadow pond had an overwhelming abundance of frog and salamander larvae. This pond represents a significant amphibian breeding area and should be preserved. High density breeding areas such as this pond act as reservoirs for amphibians that can migrate and repopulate surrounding areas disturbed by natural or anthropogenic causes. Upland Chorus Frogs (*Pseudacris feriarum*) were the only potential frog species not located within the park. This frog is often found in shallow ephemeral wetlands in open areas with abundant vegetation. Marginal habitat for this frog was found in CATO but it is not expected to be present in the park.

Turtles

Figure 4 shows the distribution of turtles observed in the study. All turtles found in the park were associated with Lantz Marsh or Owens Creek. Wood Turtles (*Glyptemys insculpta*) were found in the marsh and most likely utilize Owens Creek. One Eastern Snapping Turtle (*Chelydra serpentine*) was found in Owens Creek. Habitat for Eastern Box Turtles (*Terrapene carolina*) is found in edge or transition habitat in the park. This species is locally abundant and is often killed on motorways. Remnants of carapaces can be found infrequently throughout the habitat when it is present. No

evidence of this species was found. Spotted Turtles (*Clemmys guttata*), have distribution ranges within CATO, but no optimum habitat was observed for this species. The only potential habitat for this turtle was in the area of Lantz Marsh. Stinkpots (*Sternotherus odoratus)* are another species of turtle with a range that overlaps CATO. The only potential habitat available for this species is Owens Creek and the water temperature of the creek may be too low to support Stinkpots. This turtle also prefers slow moving streams with mud or muck bottoms; therefore Owens Creek is not optimal habitat.

Lizards

Although no lizards were captured for positive identification several lizards were observed on the dry ridges of the park. Lizard habitat is found on the exposed ridges and ledges, (such as found at "Hog Rocks") throughout the park and buildings and structures around the park.

Snakes

The distribution of snakes observed within CATO is shown in Figure 5. The forested nature of CATO does not lend itself to best habitat for the many snakes. The majority of snakes were observed on ridge tops along rights-of-way or edges of roadways. Only 4 species of snakes were observed. The Eastern Gartersnake (*Thamnophis sirtalis*) is a habitat generalist, but as with the many species of snakes is found more often on the ecotone between forests and fields or open areas such as rights-of-way. This species was found along old roads or as a roadkill. Other snakes observed within the park were snakes associated with woodland or mountain habitats of the Appalachians. Ring-necked snakes (*Diadophis p. edwardsii*) and Northern Red-bellied (*Storeria o. occipitomaculata*) snakes were also found in or close to the park. These are small non-venomous snakes that inhabit wooded areas, especially near forest edges. Northern Ring-necked snakes forage for salamanders or invertebrates, while Red-bellied snakes prefer slugs. Both species are abundant within their range and preferred habitat. Two Timber Rattlesnakes (*Crotalus horridus*) were observed. This is a species listed by the state of Maryland as "S3" and is therefore on their watch list. Timber Rattlesnakes are found in a variety of habitats and are associated with exposed slopes with rocky terrain that provide den sites. These snakes often move a great distance from their winter

refugia. This is an important forest dwelling snake and predator of small mammals (predominantly rodents such as ground squirrels). The abundance of Rattlesnakes is often inversely related to the presence of humans therefore management of the habitat is important for conservation of this animal, which is protected in many area of its range because of declining numbers. Both of the Timber Rattlesnakes encountered were within 100 yards of well-maintained hiking trails where these trails lead close to rock outcrops. The presence of what appears to be a healthy Timber Rattlesnake population in the park creates at least 2 immediate conservation concerns: How to protect people from accidental encounters and how to protect the snakes from people. Education is potentially the key to success in both endeavors. A simple warning stating Rattlesnakes live in the area will keep most visitors aware and on the paths. Education of the role of rattlesnakes in the environment and what to do if one is encountered (besides killing it…) is the first step to keeping peace between visitors and snakes in general. Warnings to over enthusiastic visitors who seek out the snakes (not to harm them but to collect them) are also needed. Monitoring the population and protecting den sites by keeping trails a safe distance from the areas is also recommended.

Fourteen other snakes have distributions that overlap CATO. Limited habitat is available for many of these species. Habitats for Common Watersnakes (*Nerodia sipedon*) and Queen Snakes (*Regina septemvittata*) were found along and in Owens Creek. These snakes are usually found along streams or ponds and are locally abundant. Eastern Wormsnakes (*Carphophis amoenus*), Eastern smooth Earthsnakes (*Virginia valeriae*), Smooth Greensnakes (*Opheodrys vernalis*) and Eastern Milksnakes (*Lampropeltis triangulum*) are often observed along road cuts and exposed banks with rock cover. Habitats for these snakes are spotty within the park due to dense tree canopy. Common Ribbonsnakes (*Thamnophis sauritus*) habitat is associated with shallow wetlands and stream banks often with abundant vegetation. Potential habitat for this species is Lantz Marsh. CATO is close to the edge of the distribution of Rough Greensnakes, a species often observed on vegetation close to water (Plummer 1997). Habitat for this species is found in edge or transition habitats in the park, but this species may be just out of its historic distribution. The abundance of this species may also be in

decline. The distribution of Eastern Hog-nosed Snakes (*Heterodon platirhinos*) overlaps that of CATO, but no significant habitat for this species was observed within the park.

Conclusion and Recommendations

The National Park Service in the Nation's Capital Region has the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation of these natural areas very important (Murphy 1988). The preservation of historic areas and natural habitats should be considered in concert.

Breeding habitat for amphibians is often created and lost by human activities. Many species breed in ephemeral ponds and ditches standing water and should be maintained and created. Simple steps such as postponing roadside ditch maintenance until after the breeding season or metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing the parks are protecting watersheds form overrun off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads, therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential Species in Catoctin Mountain Park

AMPHIBIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog
Hyla versicolor – Eastern Gray Treefrog
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog
Rana pipiens – Northern Leopard Frog**
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma jeffersonianum – Jefferson Salamander
Ambystoma maculatum – Spotted Salamander
Ambystoma opacum – Marbled Salamander**
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander
Eurycea bislineata – Northern Two-lined Salamander
Eurycea l. longicauda – Long-tailed Salamander*
Gyrinophilus p. porphyriticus – Northern Spring Salamander
Hemidactylium scutatum – Four-toed Salamander*
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon glutinosus – Northern Slimy Salamander
Plethodon hoffmani – Valley and Ridge Salamander**
Pseudotriton r. ruber – Northern Red Salamander
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft*

REPTILES

Order Testudines

Family Chelydridae

Chelydra s. serpentina – Eastern Snapping Turtle

Family Emydidae

Chrysemys p. picta – Eastern Painted Turtle**

Clemmys guttata – Spotted Turtle**

Glyptemys insculpta – Wood Turtle

Terrapene c. carolina – Eastern Box Turtle**

Family Kinosternidae

Sternotherus odoratus -- Stinkpot

Order Squamata

Suborder Lacertilia

Family Phrynosomatidae

Sceloporus undulatus – Eastern Fence-Lizard**

Family Scincidae

Eumeces fasciatus – Common Five-lined Skink**

Eumeces laticeps – Broad-headed Skink

Suborder Serpentes

Family Colubridae

Carphophis a. amoenus – Eastern Wormsnake

Coluber c. constrictor – Northern Black Racer**

Diadophis punctatus edwardsii – Northern Ring-necked Snake

Elaphe o. obsoleta – Black Ratsnake**

Heterodon platirhinos – Eastern Hog-nosed Snake**

Lampropeltis t. triangulum – Eastern Milksnake**

Nerodia s. sipedon – Common Watersnake**

Opheodrys a. aestivus – Northern Rough Greensnake

Opheodrys vernalis – Smooth Greensnake**

Regina septemvittata – Queen Snake**

Storeria d. dekayi – Northern Brownsnake

Storeria o. occipitomaculata – Northern Red-bellied Snake

Thamnophis s. sauritus – Common Ribbonsnake

Thamnophis s. sirtalis – Eastern Gartersnake

Virginia v. valeriae – Eastern Smooth Earthsnake

Family Viperidae

Agkistrodon contortrix mokasen – Northern Copperhead**

Crotalus horridus – Timber Rattlesnake

Underline denotes species found during this study

* Literature Record

** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2. Species observed by habitat at CATO

Scientific Name	Number	Common Name	Deciduous Forest	Pond	Riparian	Road	RR Track	Stream	Wetlands
Frogs and Toads									
Bufo a. americanus	3	Eastern American Toad	X				X		X
Bufo fowleri	1	Fowler's Toad							X
Hyla versicolor	1	Gray Treefrog		X					
Pseudacris c. crucifer	1	Northern Spring Peeper		X					
Rana c. melanota	1	Northern Green Frog		X					
Rana catesbeiana	1	American Bullfrog		X					
Rana palustris	3	Pickerel Frog	X	X					
Rana sylvatica	1	Wood Frog		X					
Salamanders									
Ambystoma maculatum	1	Spotted Salamander		X					
Desmognathus fuscus	2	Northern Dusky Salamander	X		X				
Eurycea bislineata	2	Northern Two-lined Salamander	X						
Gyrinophilus p. porphyriticus	5	Northern Spring Salamander			X			X	
Plethodon cinereus	18	Eastern Red-backed Salamander	X		X				
Plethodon glutinosus	11	Northern Slimy Salamander	X		X		X		
Pseudotriton r. ruber	1	Northern Red Salamander	X						

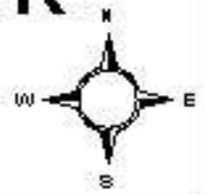
Scientific Name	Number	Common Name	Deciduous Forest	Pond	Riparian	Road	RR Track	Stream	Wetlands
Snakes									
Crotalus horridus	2	Timber Rattlesnake	**X**						
Diadophis p. edwardsii	3	Northern Ring-necked Snake	**X**						
Storeria o. occipitomaculata	1	Northern Red-bellied Snake	**X**						
Thamnophis s. sirtalis	3	Eastern Gartersnake	**X**			**X**			**X**
Turtles									
Chelydra s. serpentina	1	Eastern Snapping Turtle						**X**	
Glyptemys insculpta	4	Wood Turtle							**X**

Table 3. Summary of inventory results for CATO

Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	13	7	54
Toads	2	2	100
Frogs	9	6	67
Turtles	6	2	33
Lizards	3	0	0
Snakes	17	4	24

Catoctin Mountain Park

Herpetological Inventory



Habitats
- Deciduous Forest
- Pond
- RR Track
- Riparian
- Road
- Stream
- Wetland

Streams

Roads

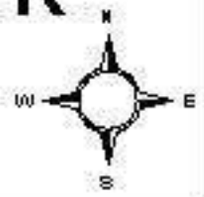
Park Boundary

500 0 500 1000 Meters

MBW April 2005

Catoctin Mountain Park

Herpetological Inventory



Salamanders

- Ambystoma maculatum
- Desmognathus fuscus
- Eurycea bislineata
- Gyrinophilus p. porphyriticus
- Plethodon cinereus
- Plethodon glutinosus
- Pseudotriton r. ruber

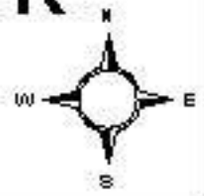
Park Boundary

500 0 500 1000 Meters

MBW April 2005

Catoctin Mountain Park

Herpetological Inventory



Frogs and Toads
- Bufo a. americanus
- Bufo fowleri
- Hyla versicolor
- Pseudacris c. crucifer
- Rana c. melanota
- Rana catesbeiana
- Rana palustris
- Rana sylvatica

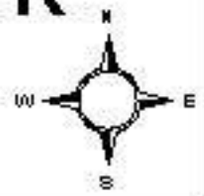
Park Boundary

500 0 500 1000 Meters

MBW April 2005

Catoctin Mountain Park

Herpetological Inventory



Turtles

- Chelydra s. serpentina
- Glyptemys insculpta

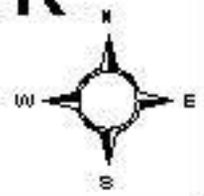
Park Boundary

500 0 500 1000 Meters

MBW April 2005

Catoctin Mountain Park

Herpetological Inventory



Snakes

- Crotalus horridus
- Diadophis p. edwardsii
- Storeria o. occipitomaculata
- Thamnophis s. sirtalis
- Park Boundary

500 0 500 1000 Meters

MBW April 2005

APPENDIX 3

REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

CHESAPEAKE AND OHIO CANAL NATIONAL HISTORIC PARK

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Figure 2. Distribution of salamander

Figure 3. Distribution of frog and toad species

Figure 4. Distribution of Lizard species

Figure 5. Distribution of snake species

Figure 6. Distribution of turtle species

Introduction

Chesapeake and Ohio Canal National Historic Park (CHOH) is situated on the southern border of Maryland and parallels the Potomac River for approximately 185 miles. The majority of the park consists of remnants of a canal, its supporting towpath and associated structures. The towpath is an approximately 10 to12 feet wide crushed stone path that follows the riverside of the canal for its length. The canal has a uniformly shallow "U" shape profile that varies in depth. The canal contains varying amounts of water, from dry or a few inches to several feet deep. Habitats surrounding the canal represent various stages of succession from the previous industrial activity. The park attracts many visitors who walk or ride bicycles on the towpath or fish or boat in the watered portions of the canal.

Although reptiles were the primary focus of the study, occurrences of amphibians were also noted. Prior to this study, few herpetological studies had been conducted in the park (Kelly, et al. 1936; Fowler 1945; McCauley 1945: Green and Pauley 1987; Mitchell 1994; Forster 2000; Thompson 2000).

Drs. Thomas K. Pauley and Mark B. Watson and graduate students from the Department of Biological Sciences at Marshall University, Huntington, WV conducted inventories from mile post 40 to the northern terminus at Cumberland MD. Dr. J. Mitchell and technicians inventoried the section from milepost 40 to the southern terminus at milepost 0.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of CHOH (Kelly et al. 1936; McCauley 1945;

Linzey and Gifford 1981; Tobey 1985; Green and Pauley 1987; Conant and Collins 1998; Ernst et al. 1994; Mitchell 1994; Petranka 1998; Mitchell and Reay 1999). A site reconnaissance was done on the initial visit and after council with CHOH personnel we identified habitat for target species. Marie Sauter was especially helpful in providing maps and guidance around the park. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data were recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of CHOH and whose habitats were located by field reconnaissance are listed in Table 1. Fifty-nine species had distributions that overlapped the boundaries of CHOH. The list of potential species is a conservative list used to guide investigation in this study and future studies.

Species Summary

A summary of species observed during field inventories of CHOH are listed in Table 2. Five species of frogs, 1 species of toads, 8 species of salamanders, 2 species of lizards, 5 species of snakes and 6 species of turtles were observed. Some of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventorying techniques, such as drift fences combined with pitfall traps, to identify their presence.

Data in Table 3 compare the number of potential species with the number of species found for each group. Most species unaccounted for were species where CHOH was located on the edge of their geographic distribution or habitat within the park was marginal.

Habitats

CHOH has many diverse habitats and because of the nature of this park several were created by humans. CHOH traverses a wide variety of spectacular geologic features while traveling from the Valley and Ridge, Piedmont and Coastal Plain, but the canal and associated towpath are uniform for many kilometers. This uniform habitat of often shaded gravel road bounded by mowed grass showed low reptile diversity. Secondary upland forests of the region are xerotolerant tree and shrub species characteristic of the dry Valley and Ridge Physiographic Province. Ridge tops in the area were dominated by mixed deciduous forest species. Understory and herbaceous layers adjacent to the towpath and canal were often dominated in many areas by exotic invasive species, especially the floodplain of the Potomac River and the towpath. Bottomland forests were characterized by typical river bottomland hardwood species including sycamore (*Platanus occidentalis*) and silver maple (*Acer saccharinum*). The Potomac River frequently floods inundating the floodplain. Anthropogenic disturbances created other habitats within the park such as rights-of-way, roads, trails, canals, ponds, rock walls, and agricultural fields. Signs of historic disturbance are also evident by the large number of old road cuts and abandoned buildings or structures. Historic structures along the canal include locks, bridges, aqueducts, houses and other buildings (Hahn 1994).

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park that were covered with agricultural fields or maintained as fields showed few species of amphibians or reptiles. Mixed deciduous forests or aquatic habitats located within the forest showed the highest number of species. Canals, creeks and rivers within the park support a variety of amphibians and turtle species. Pond and slack water turtles such as Painted Turtles (*Chrysemys picta*), and Snapping Turtles (*Chelydra serpentina*), were frequently observed in the canals and other pond-like back waters. Floodplains contained few amphibian and reptile species. Shallow fishless pools in the canal were

used as breeding areas for several frog and salamander species. Small intermittent streams draining through the park are also important habitats for several plethodontid salamander species. These shady moist habitats were inhabited by salamanders and during the dry summer, small still pools were refugia for several frog species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. Salamander species from 3 taxonomic families (Salamandridae, Ambystomatidae, and Plethodontidae) were found. Red-spotted Newts (*Notophthalmus viridescens*) were observed in the canal throughout the park. Three species of ambystomatids or mole salamanders were observed as egg masses, larvae or subadults in several locations in the canal where there were shallow fishless pools containing woody debris and permanent water. The most diverse group of salamanders observed was the plethodontids, or lungless salamanders. This family can be roughly divided into 2 groups based on habitat use: woodland salamanders and stream salamanders. Two woodland salamanders were observed Red-backed Salamander (*Plethodon cinereus*), and Valley and Ridge Salamander (*P. hoffmani*). Two species of stream salamanders were found. Theses small fishless streams are ideal habitat for several species of salamanders. Northern Two-lined Salamanders (*Eurycea bislineata*) were found in the canal and canal edges. Long-tailed Salamanders (*Eurycea longicauda*) often inhabit riparian areas and hillsides adjacent to water. This species is usually less abundant than *E. bislineata* and may be less tolerant of pollution or disturbance. This study did not focus on salamander species, but small primary streams draining into the canal and adjacent stream are habitat for other stream salamanders.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Several ranid species were observed in ponds, pools and canals. Bullfrogs (*Rana catesbeiana*), Green Frogs (*Rana melanota*), Pickerel Frogs (*Rana palustris*) and Wood Frogs (*Rana sylvatica*) were observed or heard calling in the canal. Eastern American Toads (*Bufo americanus*) were found foraging along the towpath. American Toads will breed in temporary shallow pools and puddles. Fowler's Toads (*Bufo fowleri*) were not

observed along the canal, but were observed at HAFE just across the Potomac River from CHOH. Gray Treefrogs (*Hyla versicolor*) were heard calling along the floodplain of the Potomac River and adjacent canal.

Species whose ranges overlap the park that were not observed were Northern Spring Peepers (*Pseudacris c. crucifer*), Upland Chorus Frogs (*Pseudacris f. feriarum*), Eastern Cricket Frogs (*Acris c. crepitans*) Northern Leopard Frogs (*Rana pipiens*), and Eastern Spadefoots (*Scaphiopus holbrookii*). No quality Eastern Cricket Frogs, Upland Chorus Frogs, or Northern Leopard Frogs were found in the park. Although Spadefoots were not found, this species is fossorial and only emerges when environmental conditions are suitable. Therefore, it is probably unlikely that the Spadefoots would be found during this study even if they were present within the park boundaries.

A major concern of amphibian conservation for the CHOH includes runoff from adjacent RR tracks, cities and residential populations. Much of the partially watered portions of the canal are marginal habitat for breeding amphibians because of low water quality. Application of pesticides to prevent mosquito breeding may also be detrimental to amphibians. Monitoring amphibian populations in areas treated should be an essential part of any mosquito abatement program.

Turtles

Figure 4 shows the distribution of turtles observed in the study. Most turtles observed were in the canals, creek mouths, or rivers. Most aquatic turtles were observed in canal sections containing deep water and open canopy. Course wood debris for basking was important habitat component (Wright et al. 1999). Slackwater dwelling species such as Snapping Turtles (*Chelydra serpentine*) and Painted Turtles (*Chrysemys picta*) were found the length of the canal where deep permanent water was available. Red-bellied Cooters (*Pseudemys rubriventris*) were found in the Canal and Potomac River. Habitat for Eastern Box Turtles (*Terrapene c. carolina*) was found throughout the park. Wood Turtles (*Glyptemys insculpta*) were found upstream of Cushwa Basin along the canal and floodplain. One Stinkpot (*Sternotherus odoratus*) was captured in the canal while basking on Lock 44. Habitat for this species is found in all the deep-water areas of the park. The range of Red-eared Sliders (*Trachemys s. elegans*) comes close to the park

but no individuals were observed in the park or surrounding areas. However, Forester reported finding this species in CHOH in 2000. This is a turtle that was commonly introduced by the pet trade and has become locally established in many areas. Spotted Turtles (*Clemmys guttata*) were not found during this current study but Fowler (1945), Forester (2000) and Thompson (2000) reported finding them in CHOH.

A major concern for the management of turtle species is the road kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to bury their eggs in loose soil above the normal high water levels. Often these areas are across roads or along road edges close to water; park personnel can take notice of dead turtles in these areas in early to mid summer. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations. In many areas turtles must cross the towpath or nest along the towpath where they are likely to be disturbed by visitors.

Lizards

Figure 5 shows the distribution of lizards observed within the park boundaries. There were 2 species of lizards found and both were observed on the dry ridges of Tunnel Hill close to the Paw Paw tunnel. Eastern Fence Lizards (*Sceloporus undulates*) and Five-lined Skinks (*Eumeces fasciatus*) were observed along the shale barrens overlooking the Potomac River. Habitat for these species and that of other skinks is found throughout the park. While skinks are locally abundant within their ranges, they may aestivate when environmental conditions are not optimum thus making them difficult to locate. Surprisingly few lizards were observed in CHOH although habitat was abundant. The Eastern Six-lined Racerunner (*Aspidoscelis s. sexlineata*) was not observed in the park but there is a known population is near Paw Paw, West Virginia just across the Potomac River from the Park. Extensive searches were conducted in the ridges of Tunnel Hill, but none was observed. Habitat for this species is found on the exposed shale barrens along Paw Paw section of the park.

Snakes

The distribution of snakes observed within CHOH is shown in Figure 6. Habitats for snakes are found in limited areas throughout the park. The majority of snakes were

observed on ridge tops along rights-of-way or edges of roadways. Most snakes were observed along the edges of the towpath or rock walls along foundations. Maintenance of the towpath by mowing the edges may influence the abundance of large snake species by removing cover. Visitor traffic along the towpath could also influence snake abundance. At least two snakes (Northern Ring-necked Snake, *Diadophis punctatus edwardsii,* and Eastern Gartersnake, *Thamnophis s. sirtalis*), were found dead on the towpath killed by bicycles or vehicles. Few snakes were observed, past anthropogenic disturbance may have influenced species abundance in the park. The towpath and surrounding area are essentially abandoned industrial areas. In addition the towpath for much of its length is shaded by canopy cover which limits basking areas. Northern Watersnakes (*Nerodia s. sipedon*) were the most abundant snake observed in the park. Habitat for this species is found within the water-containing portion of the canal, creeks and rivers. Black Ratsnakes (*Elaphe obsoleta*) were observed basking or crossing the towpath. This species is often observed in habitat transition zones. Two species of *Thamnophis* were observed, Eastern Gartersnakes (*T. s. sirtalis*) and Common Ribbonsnake (*T. s. sauritus*). Eastern Gartersnakes were observed along the towpath. One Common Ribbonsnake was observed on the edge of canal at lock 70 near Old Town, Maryland.

Several species of snakes not observed are rare in this area or the near the edge of their range. Previous human activities may have extirpated or reduced the numbers of snakes in this area, but there is reason to believe they could be in the park. Queen Snakes (*Regina septemvittata*) are species associated with wetlands and waterways. Habitat for this species is found along the canals and rivers in the park, but this species was not observed. CHOH is close to the edge of the known distribution of Rough Greensnakes (*Opheodrys aestivus*). This species is often observed on vegetation close to water (Plummer 1997). The abundance of this species throughout its range may be in decline. . Northern Black Racers (*Coluber c. constrictor*) were not observed in the park, but CHOH is within the range of this species and habitat was found throughout the park. This species is often found in transition zones of field and forest habitats, road edges, rights-of-way and other disturbed areas. No species of snake was found in abundance in the park. Many of the larger species were less common here than in other areas. Ratsnakes

and Racers frequently fall victim to vehicular traffic while crossing or basking on roads. The large number of roads and high traffic may contribute to the low number of these species observed. Eastern Wormsnake (*Carphophis amoenus*) habitat was found on floodplain forest and forest edges, but this species was not observed. Dry conditions may have reduced the surface abundance of Wormsnakes during the study period. Distribution ranges of 3 *Lampropeltis* species overlap the park, *L. g. getula* (Eastern Kingsnake), *L. t. triangulum* (Eastern Milksnake) and *L. c. rhombomaculata* (Mole Kingsnake). Kingsnakes and Milksnakes are locally abundant and often prey on other snake species. Habitat for these species includes open grassy areas with abundant cover objects often close to habitat edges. Northern Brownsnakes and Eastern Hog-nosed Snakes were not observed in the study but were reported in the CHOH by Thompson (2000) and Forester (2000), respectively.

The size and geographic range bisected by the CHOH makes it unique among the National Parks. The potential exists for a wide range of snake species in this park. Frequent mowing and removal of woody debris from field edges within the park to facilitate mowing leads to low habitat diversity. Mowing also directly kills snakes hiding or hunting in grass. The closed canopy along the towpath reduced the available basking areas for snakes. Frequent flooding also reduces species diversity along the Potomac River floodplain; therefore upland areas should be targeted for any potential habitat improvement for snakes.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitats for amphibians are often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water, especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that

lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or the metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing the parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential Species in C & O Canal National Historic Park

AMPHIBIANS

Order Anura

Family Bufonidae

Bufo a. americanus – Eastern American Toad

Bufo fowleri – Fowler's Toad*

Family Hylidae

Acris c. crepitans – Eastern Cricket Frog*

Hyla cinerea – Green Treefrog

Hyla chrysoscelis – Cope's Gray Treefrog*

Hyla versicolor – Eastern Gray Treefrog

Pseudacris c. crucifer – Northern Spring Peeper*

Pseudacris f. feriarum – Upland Chorus Frog*

Family Pelobatidae

Scaphiopus holbrookii – Eastern Spadefoot

Family Ranidae

Rana catesbeiana – American Bullfrog

Rana clamitans melanota – Northern Green Frog

Rana palustris – Pickerel Frog

Rana pipiens – Northern Leopard Frog

Rana sphenocephala utricularia – Southern Leopard Frog*

Rana sylvatica – Wood Frog

Order Caudata

Family Ambystomatidae

Ambystoma jeffersonianum – Jefferson Salamander

Ambystoma maculatum – Spotted Salamander

Ambystoma opacum – Marbled Salamander

Family Plethodontidae

Desmognathus fuscus – Northern Dusky Salamander*

Desmognathus monticola – Seal Salamander

Eurycea bislineata – Northern Two-lined Salamander

Eurycea l. longicauda – Long-tailed Salamander

Gyrinophilus p. porphyriticus – Northern Spring Salamander**

Hemidactylium scutatum – Four-toed Salamander*

Plethodon cinereus – Eastern Red-backed Salamander

Plethodon glutinosus – Northern Slimy Salamander*

Plethodon hoffmani – Valley and Ridge Salamander

Pseudotriton m. montanus – Eastern Mud Salamander**

Pseudotriton r. ruber – Northern Red Salamander*

Family Salamandridae

Notophthalmus v. viridescens – Red-spotted Newt, Red Eft

REPTILES

Order Testudines

Family Chelydridae

Chelydra s. serpentina – Eastern Snapping Turtle

Family Emydidae

Chrysemys p. picta – Eastern Painted Turtle

Clemmys guttata – Spotted Turtle*

Glyptemys insculpta – Wood Turtle

Malaclemys t. terrapin – Northern Diamond-backed Terrapin*

Pseudemys rubriventris – Northern Red-bellied Cooter

Terrapene c. carolina – Eastern Box Turtle

*Trachemys scripta elegan*s – Red-eared Slider*

Family Kinosternidae

Kinosternon subrubrum – Eastern Mud Turtle*

Sternotherus odoratus – Stinkpot

Order Squamata

Suborder Lacertilia

Family Phrynosomatidae

Sceloporus undulatus - Eastern Fence-Lizard

Family Scincidae

Eumeces fasciatus – Common Five-lined Skink

Eumeces laticeps – Broad-headed Skink

Scincella lateralis – Little Brown Skink

Family Teiidae

Aspidoscelis s. sexlineata – Eastern Six-lined Racerunner**

Suborder Serpentes

Family Colubridae

Carphophis a. amoenus – Eastern Wormsnake*

Coluber c. constrictor – Northern Black Racer*

Diadophis punctatus edwardsii – Northern Ring-necked Snake

Elaphe g. guttata – Cornsnake**

Elaphe o. obsoleta – Black Ratsnake

Farancia e. erytrogramma – Common Rainbow Snake**

Heterodon platirhinos – Eastern Hog-nosed Snake*

Lampropeltis calligaster rhombomaculata – Mole Kingsnake

Lampropeltis g. getula – Eastern Kingsnake**

Lampropeltis t. triangulum – Eastern Milksnake*

Nerodia s. sipedon – Common Watersnake

Opheodrys a. aestivus – Northern Rough Greensnake*

Opheodrys vernalis – Smooth Greensnake**

Regina septemvittata – Queen Snake*

*Storeria d. deka*yi – Northern Brownsnake

Storeria o. occipitomaculata – Northern Red-bellied Snake**

Thamnophis s. sauritus – Common Ribbonsnake

Thamnophis s. sirtalis – Eastern Gartersnake
Virginia v. valeriae – Eastern Smooth Earthsnake*
Family Viperidae
Agkistrodon contortrix mokasen – Northern Copperhead
Crotalus horridus – Timber Rattlesnake

Underline denotes species found during this study
* Literature Record
** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2 Species observed by habitat at CHOH

Scientific Name	Number	Common Name	Canal	Deciduous Forest	Ephemeral pool	Field	Floodplain	Lake	Pond	Right-of-way	Riparian	River	RR Track	Stream	Towpath	Tunnel	Wetland
Frogs and Toad																	
Bufo a. americanus	2	Eastern American Toad		**X**											**X**		
Hyla versicolor	1	Gray Treefrog							**X**								
Rana c. melanota	7	Northern Green Frog	**X**		**X**				**X**								
Rana catesbeiana	4	American Bullfrog	**X**		**X**				**X**								
Rana palustris	1	Pickerel Frog													**X**		
Rana sylvatica	1	Wood Frog									**X**						
Salamanders																	
Ambystoma jeffersonianum	1	Jefferson Salamander		**X**													
Ambystoma maculatum	3	Spotted Salamander		**X**													
Ambystoma opacum	1	Marbled Salamander	**X**														
Eurycea bislineata	1	Northern Two-lined Salamander							**X**								

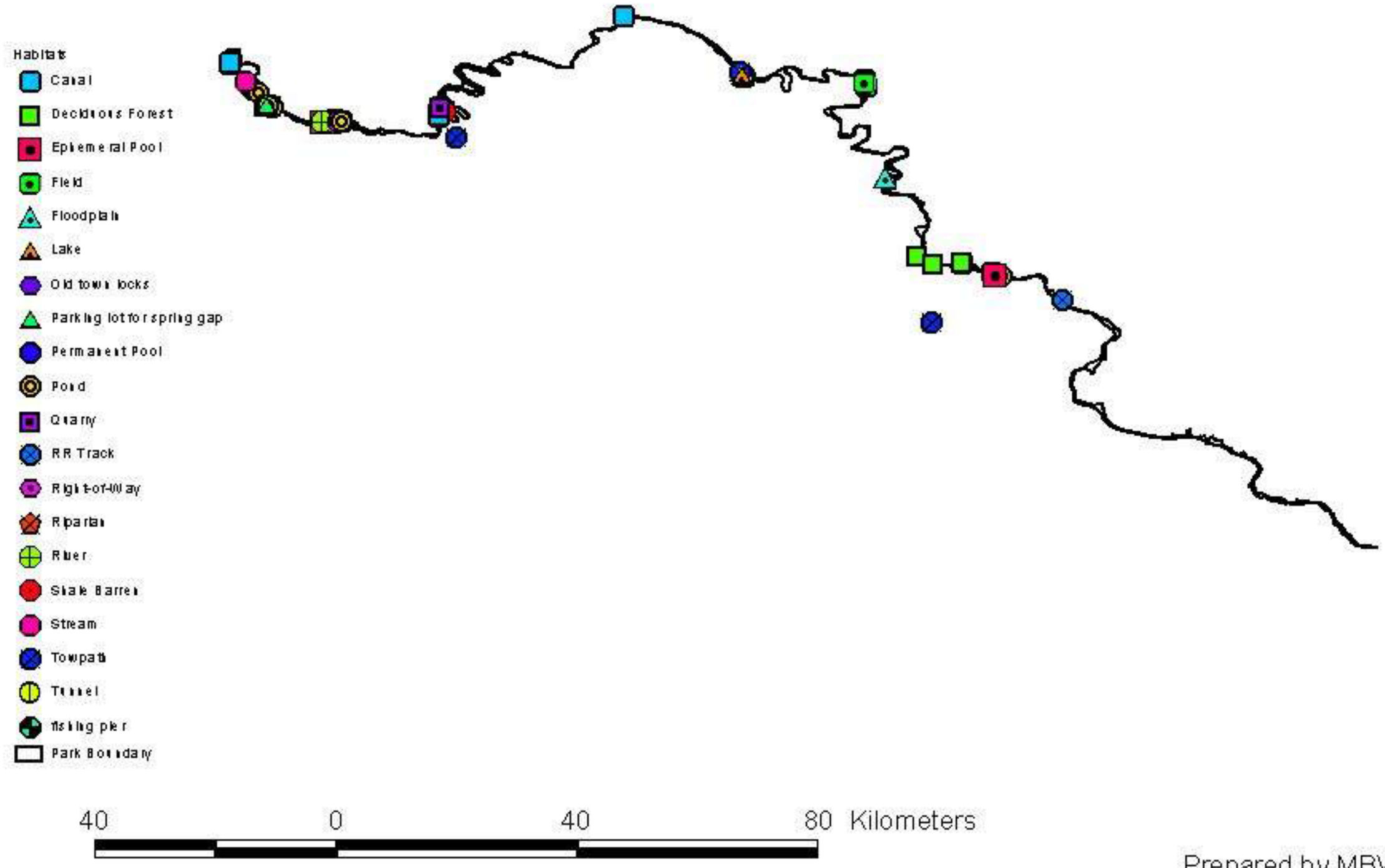
Scientific Name	Number	Common Name	Canal	Deciduous Forest	Ephemeral pool	Field	Floodplain	Lake	Pond	Right-of-way	Riparian	River	RR Track	Stream	Towpath	Tunnel	Wetland
Eurycea longicauda	4	Long-tailed Salamander		X									X				
Notophthalmus v. viridescens	3	Red-spotted Newt							X							X	
Plethodon cinereus	2	Eastern Red-backed Salamander											X				
Plethodon hoffmani	1	Valley and Ridge Salamander		X													
Lizards																	
Eumeces fasciatus	1	Five-lined Skink		X													
Sceloporus undulates	1	Eastern Fence Lizard		X													
Snakes																	
Diadophis p. edwardsii	3	Northern Ring-necked Snake		X	X										X		
Elaphe o. obsolete	8	Black Ratsnake													X	X	
Nerodia s. sipedon	10	Common Watersnake						X	X					X			

Scientific Name	Number	Common Name	Canal	Deciduous Forest	Ephemeral pool	Field	Floodplain	Lake	Pond	Right-of-way	Riparian	River	RR Track	Stream	Towpath	Tunnel	Wetland
Thamnophis s. sauritus	1	Common Ribbonsnake							X								
Thamnophis s. sirtalis	4	Eastern Gartersnake		X		X							X				
Turtles																	
Chelydra s. serpentina	15	Eastern Snapping Turtle	X	X				X	X			X					
Chrysemys p. picta	106	Eastern Painted Turtle	X	X				X	X	X							
Glyptemys insculpta	2	Wood Turtle								X							
Pseudemys rubriventris	10	Northern Red-bellied Cooter			X	X			X			X					
Sternotherus odoratus	1	Stinkpot	X														
Terrapene c. carolina	3	Eastern Box Turtle	X	X			X										

Table 3. Summary of Inventory Results for CHOH

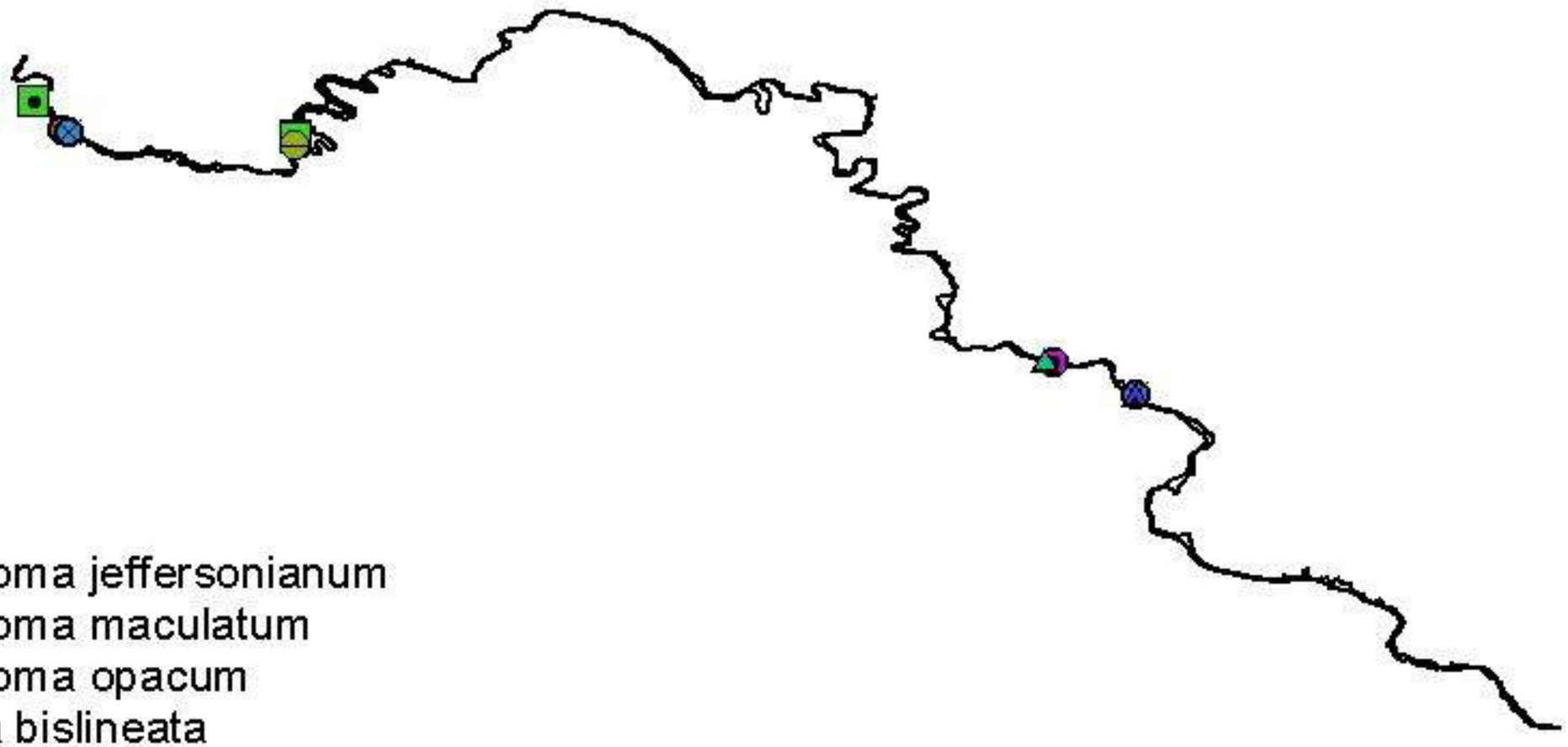
Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	15	8	53
Toads	3	1	33
Frogs	12	5	42
Turtles	10	6	60
Lizards	5	2	40
Snakes	21	5	24

Chesapeake and Ohio Canal Herpetological Inventories



Prepared by MBW June 14, 2005

Chesapeake and Ohio Canal Herpetological Inventories



Salamanders
- Ambystoma jeffersonianum
- Ambystoma maculatum
- Ambystoma opacum
- Eurycea bislineata
- Eurycea longicauda
- Notophthalmus v. viridescens
- Plethodon cinereus
- Plethodon hoffmani

Park Boundary

40 0 40 80 Kilometers

Prepared by MBW June 14, 2005

Chesapeake and Ohio Canal Herpetological Inventories

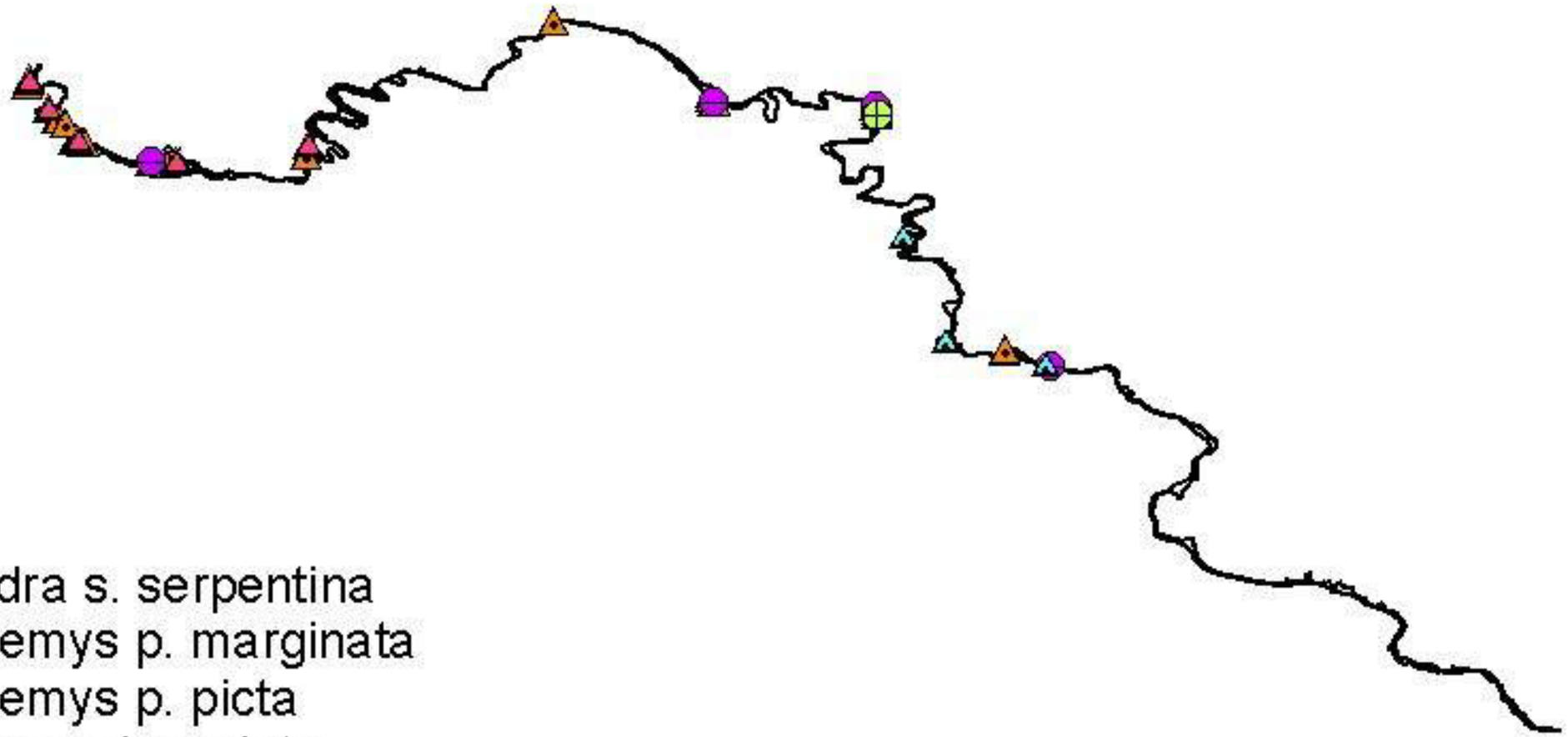


Frogs and Toads
- Bufo a. americanus
- Hyla versicolor
- Rana c. melanota
- Rana catesbeiana
- Rana palustris
- Rana sylvatica
- Park Boundary

40 0 40 80 Kilometers

Prepared by MBW June 14, 2005

Chesapeake and Ohio Canal Herpetological Inventories

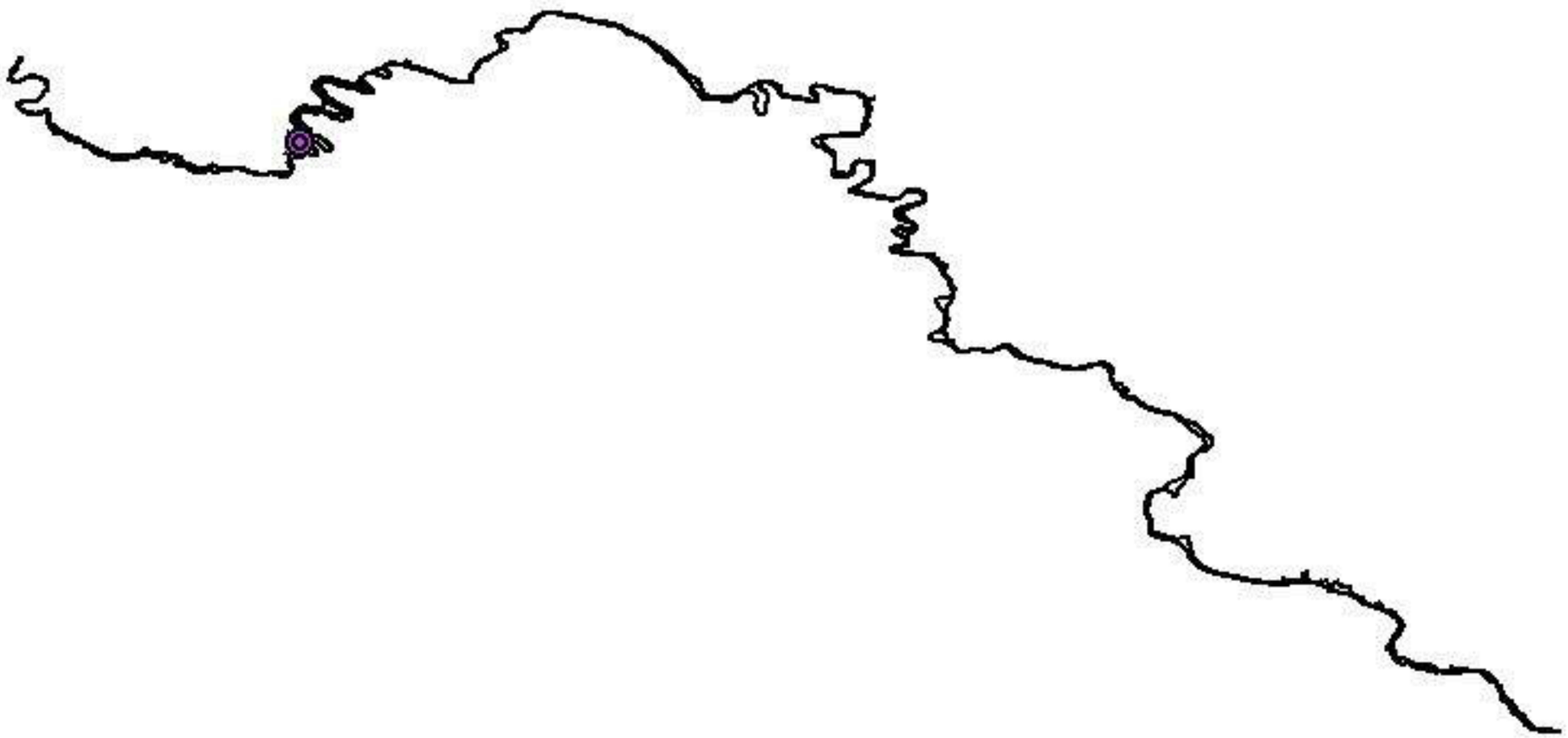


Turtles
- Chelydra s. serpentina
- Chrysemys p. marginata
- Chrysemys p. picta
- Glyptemys insculpta
- Pseudemys rubriventris
- Sternotherus odoratus
- Terrapene c. carolina
- Park Boundary

40 0 40 80 Kilometers

Prepared by MBW June 14, 2005

Chesapeake and Ohio Canal Herpetological Inventories



Lizards

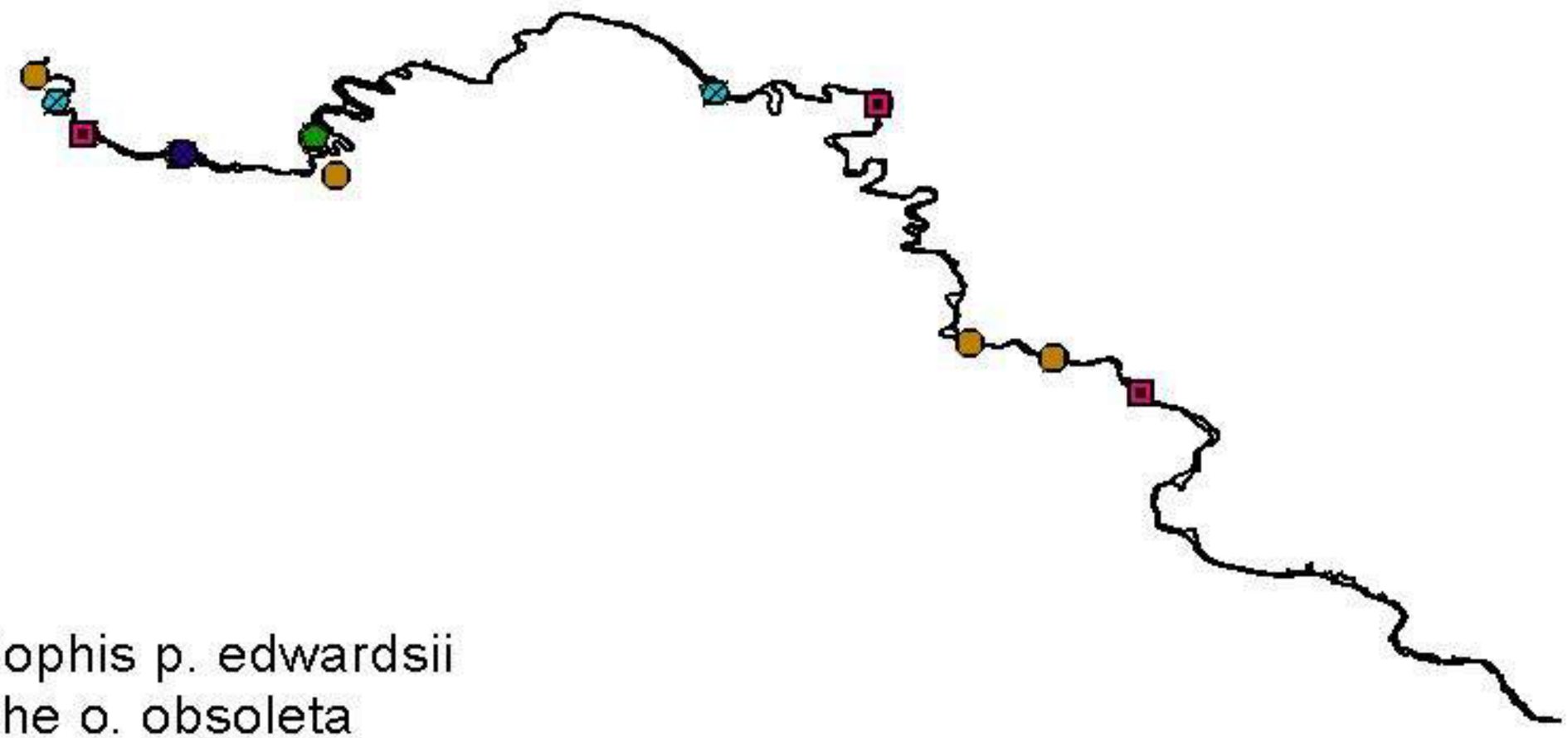
- Eumeces fasciatus
- Sceloporus undulatus

Park Boundary

40 0 40 80 Kilometers

Prepared by MBW June 14, 2005

Chesapeake and Ohio Canal Herpetological Inventories



Snakes
- Diadophis p. edwardsii
- Elaphe o. obsoleta
- Nerodia s. sipedon
- Thamnophis s. sauritus
- Thamnophis s. sirtalis

Park Boundary

40 0 40 80 Kilometers

Prepared by MBW June 14, 2005

APPENDIX 4

REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

GEORGE WASHINGTON MEMORIAL PARKWAY

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Figure 4. Distribution of Lizard species

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Introduction

The George Washington Memorial Parkway (GWMP) extends from Mount Vernon to the Great Falls of the Potomac River. While it helps preserve flora and fauna along the river as well as the river's shoreline and watershed, the area is landscaped and well maintained. GWMP serves as a route to scenic, historic and recreational venues in a largely metropolitan area and thus provides unique experiences in a natural setting for millions of people.

Dr. J. Mitchell and technicians from University of Richmond, VA conducted inventories in GWMP.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of GWMP (Kelly et al. 1936; McCauley 1945; Linzey and Gifford 1981; Tobey 1985; Green and Pauley 1987, Conant and Collins 1998; Ernst et al. 1994; Mitchell 1994; Petranka 1998; Mitchell and Reay 1999). A site reconnaissance was done on the initial visit, and after council with GWMP personnel we identified habitat for target species. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data was recorded onto

standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Habitats of potential species found within the boundaries of GWMP were located by field reconnaissance (Table 1). Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Fifty-five species had distributions that overlapped the boundaries of GWMP. The list of potential species is a conservative list used to guide investigation in this study and future studies.

Species Summary

A summary of species observed during field inventories of GWMP are listed in Table 2. Seven species of frogs, 2 species of toads, 6 species of salamanders, 2 species of lizards, 9 species of snakes and 6 species of turtles were observed. Several of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventorying techniques, such as drift fences combined with pitfall traps, to identify their presence.

Table 3 compares the number of potential species with the number of species found for each group. Most species that were unaccounted for were species where GWMP was located on the edge of its geographic distribution or habitat within the park was marginal.

Habitats

GWMP follows the Potomac River from Great Falls, Virginia to Mount Vernon. The park contains a wide variety of habitats ranging from approximately 100 year-old secondary growth hardwood forests in the Great Falls area to freshwater tidal marsh wetlands of Dyke Marsh, to urban areas.

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park that were mostly in an urban setting or maintained as fields yielded few species of amphibians or reptiles. Mixed deciduous forests or aquatic habitats located within the forest had the highest number of species. Canals, creeks, rivers, and wetlands

within the park support a variety of amphibians and turtle species. Pond and slack water turtles such as Painted Turtles (*Chrysemys picta*), and Snapping Turtles (*Chelydra serpentina*), were frequently observed in the canals and other pond-like back waters. Floodplains contained few amphibians and reptiles. Ephemeral or permanent fishless pools in the floodplain of the Potomac River were used as breeding areas for several frog and salamander species. Small intermittent streams draining the park are also important habitats for several plethodontid salamander species. These shady moist habitats were inhabited by salamanders and during the dry summer, small still pools were refugia for several frog species.

Salamanders

Distribution of salamander species observed in the park is shown in Figure 2. A diversity of salamander species from 3 taxonomic families were found. One species of Salamandridae, 1 Ambystomatidae, and 4 Plethodontidae were observed. The 1 species of Salamandridae, Red-spotted Newt (*Notophthalmus viridescens*), was observed in permanent pools within the park.

One species of Ambystomatidae, *Ambystoma maculatum*, was observed as egg masses, larvae and subadults in several locations in flood scour pools in Great Falls. The most diverse group of salamanders found in eastern forests is the plethodontids, or lungless salamanders. This family can be roughly divided into groups based on habitat use: woodland salamanders and stream salamanders. Only one woodland salamander, Red-backed Salamander (*Plethodon cinereus*) was observed. Small fishless streams are ideal habitat for many species of stream salamanders. Two species of stream salamanders, Northern Dusky Salamanders (*Desmognathus fuscus*) and Northern Two-lined Salamanders (*Eurycea bislineata*), were the only stream salamanders found. Three-lined Salamanders (*Eurycea guttolineata*) often inhabit riparian areas and floodplain forested habitats. This species was not observed, but its habitat is found in floodplain forests of Great Falls and Turkey Run parks. Ranges of two wetland salamanders, Northern Red Salamanders (*Pseudotriton ruber*) and Four-toed Salamanders (*Hemidactylium scutatum*) are with the GWMP. Both species can be located along the edges of wetlands where they forage or deposit eggs. Northern Red Salamanders also inhabit 1st order streams. Female Four-toed Salamanders tend their clutch of eggs for

about 2 months and can often be located at the edge of wetlands under vegetation or mosses. Four-toed salamanders were observed in floodplain forest of Great Falls. Northern Red Salamanders are often found in the same habitats as Four-toed Salamanders, but none was observed.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Several ranid species were observed in ponds, pools, and canals. American Bullfrogs (*Rana catesbeiana*), Northern Green Frogs (*Rana c. melanota*), Wood Frogs (Rana sylvatica) and Pickerel Frogs (*Rana palustris*) were observed. Eastern American Toads (*Bufo a. americanus*) were observed breeding in flood scour pools in Great Falls. American Toads will breed in many temporary shallow pools and puddles. Fowler's Toads (*Bufo fowleri*) were observed at Turkey Run Park. Several treefrog species are found in the park. Northern Spring Peepers (*Pseudacris c. crucifer*) were found in standing water, especially in Great Falls Park and Turkey Run Park. Gray Treefrogs (*Hyla versicolor*) were heard calling along the floodplain of the Potomac River. Ranges of *Hyla versicolor* and a sibling species, *Hyla chrysoscelis*, occur in the GWMP. Over 700 *H. chrysoscelis* was observed and just one *H. versicolor* was recorded. The major field characteristic used to separate these 2 species is the frequency of their calls and air and water temperatures can alter this. More work may be needed to determine if this one specimen was *H. versicolor* or just a call variation of *H. chrysoscelis* because of temperatures.

Species whose ranges overlap the park that were not observed were Eastern Cricket Frogs (*Acris c. crepitans*), Upland Chorus Frog (*Pseudacris f. feriarum*), and Eastern Spadefoots (*Scaphiopus holbrookii*). Quality habitats of the first 2 species were found in the park. Although no Spadefoots were found, this species is fossorial and only emerges when environmental conditions are suitable. It is, therefore, probably unlikely that Spadefoots would be found during this study even if they were present within the park boundaries. Sandy areas adjacent to the floodplain of the river and low areas of the park that collect standing water for several days after late spring and summer heavy rain or flood events are potential breeding areas for this toad. Park personnel reported a

Spadefoot at Great Falls Park in 2003. The authors of this report have not confirmed the identity of this specimen.

Northern Leopard Frog (*Rana pipiens*) habitat was found in the park at Dyke Marsh. While we found a similar species, Pickerel Frogs (*Rana palustris*), it is possible that Leopard Frogs could also be there. Northern Leopard Frogs are declining in many areas of their range and this marsh could be an important conservation area for this species.

A major concern of amphibian conservation for the GWMP includes runoff from roads, cities and residential populations. Isolated populations of amphibians are vulnerable to extirpation from road kills and other related mortality during spring breeding migrations. Monitoring and modifying traffic patterns may be necessary to protect migrating amphibians especially mass migrations that may occur during warm rainy nights in the spring.

Turtles

Figure 4 shows the distribution of turtles observed in the study. GWMP has a diversity of turtle species. Most turtles observed were in ponds, creek mouths or rivers. Only two potential turtle species were not observed: Wood Turtles (*Glyptemys insculpta*) and Spotted Turtles (*Clemmys guttata*). These wetland dwelling species can be locally abundant. Aquatic turtles such as Eastern Snapping Turtles (*Chelydra serpentina*) and Painted Turtles (*Chrysemys picta*) were found in pond or slackwater habitat along the Potomac River. Red-bellied Cooters (*Pseudemys rubriventris*) were found in the Potomac River. Habitat for Eastern Box Turtles (*Terrapene c. carolina*) was found throughout the upland areas of the park. One Stinkpot (*Sternotherus odoratus*) was captured in Clay Pond. Habitat for this species is found in all the deep-water areas of the park. Red-eared Sliders (*Trachemys s. elegans*) were observed around Roosevelt Island. This is a turtle that was commonly introduced by the pet trade and has become locally established in many areas.

A major concern for the management of turtle species is the road kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to bury their eggs in loose soil above the normal high water levels. Often these areas are across or along road edges close to water;

park personnel can take notice of dead turtles in these areas in early to mid summer. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations.

Lizards

Figure 5 shows the distribution of lizards observed within the park boundaries. Two species of skinks, Broad-headed Skink (*Eumeces laticeps*) and Five-lined Skinks (*Eumeces fasciatus*), were observed in several areas of the park. Open areas, especially with woody debris or other structure are habitat for these species and other lizards such as Eastern Fence Lizards (*Sceloporus undulates*), which were not observed. Habitats for skinks and lizards occur throughout the park. These species can be locally abundant within their ranges.

Snakes

The distribution of snakes observed within GWMP is shown in Figure 6. Habitat for snakes is found in limited areas throughout the park. Such habitats included transition or edges of habitats especially in disturbed areas such as rock walls, foundations or other debris. The majority of snakes were observed in the area of Great Falls Park. Visitor traffic along paths and roads could influence snake abundance. Common Watersnakes (*Nerodia s sipedon*) and Northern Ring-necked Snakes (*Diadophis p. edwardsii*) were the most abundant snakes observed in the park. Habitat for Common Watersnakes includes creeks and rivers and wetlands. Northern Ring-necked Snakes often feed on salamanders and are found on forest edges or open forested habitats.

Black Ratsnakes (*Elaphe obsoleta*) were observed basking in edge habitats. This species is often observed in habitat transition zones. Northern Black Racers (*Coluber c. constrictor*) were found in transition zones of field and forest habitats, road edges, rights-of-way and other disturbed areas. Eastern Gartersnakes (*Thamnophis s. sirtalis*) are often found in similar habitats as Northern Black Racers or Black Ratsnakes. Eastern Gartersnakes were found on floodplain of Difficult Run. Eastern Wormsnakes (*Carphophis amoenus*) were found on floodplain forest of Difficult Run, habitat for this species also includes forest edges. The distribution range of 3 *Lampropeltis* species, *L. g. getula* (Eastern Kingsnake), *L. t. triangulum* (Eastern Milksnake) and *L. c. rhombomaculata* (Mole Kingsnake), overlaps the park. Kingsnakes and Milksnakes are

locally abundant and often prey on other snake species. Habitat for these species includes open grassy areas of the park with abundant cover objects often close to habitat edges or riparian areas. No Eastern Kingsnakes were observed. One Mole Kingsnake was found dead on a trail in Turkey Run Park in the riparian area of the Potomac River. Eastern Milksnakes were observed in several locations in the park along rock walls. Two Northern Copperheads (*Agkistrodon c. mokasen*) were observed. This species is often found in riparian or disturbed areas with adequate cover objects.

Several species of snakes not observed are rare in this area or the near the edge of their range. Previous human activities may have extirpated or reduced the numbers of snakes in this area, but there is reason to believe they could be in the park. Common Ribbonsnake (*Thamnophis s. sauritus*) habitat was observed at Dyke Marsh and other wetlands in the park, but this species was not observed. GWMP is within distribution of Rough Greensnakes, this species is often observed on vegetation close to water (Plummer 1997). Habitat for this species is found throughout the park, especially in riparian zones. Abundance of this species may also be in decline. No species of snake was found in abundance in the park. Many of the larger species were less common here than in other areas. Ratsnakes and Racers frequently fall victim to vehicular traffic while crossing or basking on roads. The large number of roads and high traffic may contribute to the low number of these species and other species. One Northern Black Racer (*Coluber c. constrictor*) was found dead on a road and one Mole Kingsnake was found dead on a trail. Foraging or basking snakes are often killed on roads.

The geographic location of the GWMP makes it an important conservation zone in the urbanized Washington, D.C. area. The habitats protected in GWMP are ecological islands where few species can emigrate, therefore protection of habitat is important for long-term survival of most species therein. Some snakes like other reptiles are long-lived with low fecundancy, therefore local extirpation is a constant threat. Removal of only a few breeding females can be catastrophic to local snake populations especially in urban parks. Frequent mowing and removal of woody debris from field edges within the park to facilitate mowing leads to low habitat diversity. Mowing also directly kills snakes hiding or hunting in grass. Frequent flooding also reduces species diversity along the

Potomac River floodplain, but produces specialized habitats, therefore upland areas should be targeted for any potential habitat improvement for snakes.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitats for amphibians are often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water, especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or the metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing the parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential Species in George Washington Memorial Parkway

AMPHIBIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog*
Hyla chrysoscelis – Cope's Gray Treefrog
Hyla cinerea – Green Treefrog
Hyla versicolor – Eastern Gray Treefrog**
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog
Rana sphenocephala utricularia – Southern Leopard Frog*
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma maculatum – Spotted Salamander
Ambystoma opacum – Marbled Salamander**
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander
Eurycea bislineata – Northern Two-lined Salamander
Eurycea guttolineata – Three-lined Salamander
Hemidactylium scutatum – Four-toed Salamander
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon cylindraceus – White-spotted Slimy Salamander
Pseudotriton m. montanus – Eastern Mud Salamander
Pseudotriton r. ruber – Northern Red Salamander*
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft

REPTILES
Order Testudines
Family Chelydridae
Chelydra s. serpentina – Eastern Snapping Turtle
Family Emydidae
Chrysemys p. picta – Eastern Painted Turtle
Clemmys guttata – Spotted Turtle*
Glyptemys insculpta – Wood Turtle**
Pseudemys rubriventris – Northern Red-bellied Cooter

Terrapene c. carolina – Eastern Box Turtle
Trachemys scripta elegans – Red-eared Slider

Family Kinosternidae

Kinosternon s. subrubrum – Eastern Mud Turtle**
Sternotherus odoratus – Stinkpot

Order Squamata

Suborder Lacertilia

Family Phrynosomatidae

Sceloporus undulatus – Eastern Fence-Lizard**

Family Scincidae

Eumeces fasciatus – Common Five-lined Skink
Eumeces laticeps – Broad-headed Skink
Scincella lateralis – Little Brown Skink*

Suborder Serpentes

Family Colubridae

Carphophis a. amoenus – Eastern Wormsnake
Cemophora coccinea copei – Northern Scarletsnake**
Coluber c. constrictor – Northern Black Racer
Diadophis punctatus edwardsii – Northern Ring-necked Snake
Elaphe g. guttata – Cornsnake**
Elaphe o. obsoleta – Black Ratsnake
Heterodon platirhinos – Eastern Hog-nosed Snake
Lampropeltis g. getula – Eastern Kingsnake
Lampropeltis t. triangulum – Eastern Milksnake
Lampropeltis calligaster rhombomaculata – Mole Kingsnake
Nerodia s. sipedon – Common Watersnake
Opheodrys a. aestivus – Northern Rough Greensnake*
Regina septemvittata – Queen Snake*
Storeria d. dekayi – Northern Brownsnake**
Storeria o. occipitomaculata – Northern Red-bellied Snake
Thamnophis s. sauritus – Common Ribbonsnake
Thamnophis s. sirtalis – Eastern Gartersnake
Virginia v. valeriae – Eastern Smooth Earthsnake

Family Viperidae

Agkistrodon contortrix mokasen – Northern Copperhead

Underline denotes species found during this study
* Literature Record
** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2 Species observed by habitat at GWMP

Scientific Name	Number	Common Name	Deciduous Forest	Emergent Rocks	Ephemeral Pool	Field	Floodplain	Old Field	Parking Lot	Permanent Pool	Pond	Riparian	River	Road	Rock Chimney	Rock Lined Pool	Rock Outcrop	Rock Wall	Scour Pool	Stream	Wetland
Frogs and Toads																					
Bufo a. americanus	12	Eastern American Toad	X						X	X				X				X		X	
Bufo fowleri	5	Fowler's Toad	X						X											X	
Hyla chrysoscelis	718	Cope's Gray Treefrog			X					X	X								X		
Hyla versicolor	1	Gray Treefrog								X											
Pseudacris c. crucifer	5	Northern Spring Peeper			X						X										
Rana c. melanota	12	Northern Green Frog			X					X										X	X
Rana catesbeiana	16	American Bullfrog							X	X	X									X	
Rana palustris	9	Pickerel Frog			X		X					X									
Rana sylvatica	10	Wood Frog			X															X	X
Salamanders																					
Ambystoma maculatum	221	Spotted Salamander	X		X					X	X					X			X		X

Scientific Name	Number	Common Name	Deciduous Forest	Emergent Rocks	Ephemeral Pool	Field	Floodplain	Old Field	Parking Lot	Permanent Pool	Pond	Riparian	River	Road	Rock Chimney	Rock Lined Pool	Rock Outcrop	Rock Wall	Scour Pool	Stream	Wetland
Desmognathus fuscus	4	Northern Dusky Salamander									X										X
Eurycea bislineata	10	Northern Two-lined Salamander										X								X	
Hemidactylium scutatum	4	Four-toed Salamander																			X
Notophthalmus v. viridescens	3	Red-spotted Newt									X										
Plethodon cinereus	73	Eastern Red-backed Salamander	X		X						X	X									X
Lizards																					
Eumeces fasciatus	12	Common Five-lined Skink	X		X			X	X			X									X
Eumeces laticeps	5	Broad-headed Skink										X					X				
Snakes																					
Agkistrodon c. mokasen	5	Northern Copperhead													X					X	
Carphophis a. amoenus	8	Eastern Wormsnake					X							X	X						

Scientific Name	Number	Common Name	Deciduous Forest	Emergent Rocks	Ephemeral Pool	Field	Floodplain	Old Field	Parking Lot	Permanent Pool	Pond	Riparian	River	Road	Rock Chimney	Rock Lined Pool	Rock Outcrop	Rock Wall	Scour Pool	Stream	Wetland
Coluber c. constrictor	4	Northern Black Racer												X							
Diadophis p. edwardsii	10	Northern Ring-necked Snake	X	X							X				X						
Elaphe o. obsoleta	2	Black Ratsnake				X			X												
Lampropeltis c. rhombomaculata	1	Mole Kingsnake										X									
Lampropeltis t. triangulum	5	Eastern Milksnake													X			X			
Nerodia s. sipedon	10	Common Watersnake									X						X	X			X
Thamnophis s. sirtalis	4	Eastern Gartersnake	X				X														
Turtles																					
Chelydra s. serpentina	13	Eastern Snapping Turtle					X				X	X								X	
Chrysemys p. picta	34	Eastern Painted Turtle									X	X									X
Pseudemys rubriventris	6	Northern Red-bellied Cooter									X	X	X								

Wetland			
Stream			
Scour Pool			
Rock Wall			
Rock Outcrop			
Rock Lined Pool			
Rock Chimney			
Road			
River			
Riparian			X
Pond			
Permanent Pool			
Parking Lot	X		
Old Field			
Floodplain		X	
Field			
Ephemeral Pool			
Emergent Rocks			
Deciduous Forest		X	
Common Name	Stinkpot	Eastern Box Turtle	Red-Eared Turtle
Number	4	11	1
Scientific Name	*Sternotherus odoratus*	*Terrapene c. carolina*	*Trachemys s. elegans*

Table 3. Summary of Inventory Results for GWMP

Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	11	6	55
Toads	2	2	100
Frogs	11	7	64
Turtles	9	6	67
Lizards	4	2	50
Snakes	19	9	47

George Washington Memorial Parkway Herpetological Inventory

Habitat
- Canal
- Deciduous Forest
- Emergent Rocks
- Ephemeral Pool
- Field
- Floodplain
- Old Field
- Parking Lot
- Permanent Pool
- Pond
- Riparian
- River
- Road
- Rock Lined Pool
- Rock Outcrop
- Rock Wall
- Rock chimney
- Rockpile
- Rockwall
- Scour Pool
- Stream
- Towpath
- Wetland

Gwmp bound.shp

5000 0 5000 10000 Meters

George Washington Memorial Parkway Herpetological Inventory

Salamanders
- Ambystoma maculatum
- Desmognathus fuscus
- Eurycea bislineata
- Hemidactylium scutatum
- Notophthalmus v. viridescens
- Plethodon cinereus
- Gwmp bound.shp

5000 0 5000 10000 Meters

George Washington Memorial Parkway Herpetological Inventory

Frogs and Toads
- Bufo a. americanus
- Bufo fowleri
- Hyla chrysoscelis
- Hyla versicolor
- Pseudacris c. crucifer
- Rana c. melanota
- Rana catesbeiana
- Rana palustris
- Rana sylvatica
- Gwmp bound.shp

5000 0 5000 10000 Meters

George Washington Memorial Parkway Herpetological Inventory

Turtles
- Chelydra s. serpentina
- Chrysemys p. picta
- Pseudemys rubriventris
- Sternotherus odoratus
- Terrapene c. carolina
- Trachemys s. elegans

Gwmp bound.shp

5000 0 5000 10000 Meters

George Washington Memorial Parkway Herpetological Inventory

Lizards
- Eumeces fasciatus
- Eumeces laticeps
- Gwmp bound.shp

5000 0 5000 10000 Meters

George Washington Memorial Parkway Herpetological Inventory

Snakes
- Agkistrodon c. mokasen
- Carphophis a. amoenus
- Coluber c. constrictor
- Diadophis p. edwardsii
- Elaphe o. obsoleta
- Lampropeltis c. rhombomaculata
- Lampropeltis t. triangulum
- Nerodia s. sipedon
- Thamnophis s. sirtalis
- Gwmp bound.shp

5000 0 5000 10000 Meters

APPENDIX 5

FINAL REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

HARPERS FERRY NATIONAL HISTORIC PARK

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Figure 5. Distribution of lizard species

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Introduction

Harpers Ferry National Historic Park (HAFE), located at the confluence of the Potomac and Shenandoah rivers in the Blue Ridge Mountains, is comprised of over 2,500 acres. Approximately 70% of the park is eastern deciduous forest with Oak (*Quercus prinus*), Tulip popular (*Lirodendron tuliperifera*), and Maple (*Acer rubrum*) as dominant species. The park is in the transitional zone between the wet climate of the Atlantic slope and the drier Allegheny Mountains.

Prior to this study, few herpetological studies had been conducted in the park (Green and Pauley 1987). Drs. Thomas K. Pauley and Mark B. Watson and graduate students from the Department of Biological Sciences at Marshall University, Huntington, WV conducted inventories.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here. In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of HAFE (Kelly et al. 1936; McCauley 1945; Linzey and Gifford 1981; Tobey 1985; Green and Pauley 1987; Conant and Collins 1998; Ernst et al. 1994; Mitchell 1994; Petranka 1998; Mitchell and Reay 1999). A site reconnaissance was done on the initial visit and after council with HAFE personnel we identified habitat for target species. Dale Nisbet and Bill Hebb were especially helpful in providing maps and guidance around the park. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data were recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of HAFE and whose habitats were located by field reconnaissance are listed in Table 1. For example, HAFE is within the range of Spotted Turtles, which are generally found in habitats that contain permanent shallow wetlands. Such habitats were not located within the boundaries of HAFE so the Spotted Turtle was removed from Table 1. Fifty-four species had distributions that overlapped the boundaries of HAFE. The list of potential species is a conservative list used to guide investigation in this study and future studies.

Species Summary

A summary of species observed during field inventories of HAFE are listed in Table 2. Five species of frogs, 2 species of toads, 11 species of salamanders, 2 species of lizards, 8 species of snakes and 5 species of turtles were observed. Several of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventorying techniques, such as drift fences combined with pitfall traps, to identify their presence.

Data in Table 3 compare the number of potential species with the number of species found for each group. Most species that were unaccounted for were species where HAFE was located on the edge of their geographic distribution or habitat within the Park was marginal.

Habitats

HAFE has many diverse habitats, several created by human inhabitants. Secondary forests of the region are xerotolerant tree and shrub species characteristic of the dry Valley and Ridge Physiographic Province. Ridge tops in the area were dominated by mixed deciduous forest species. The understory and herbaceous layers were often dominated in many areas by exotic invasive species, especially in the floodplain of the Potomac and Shenandoah rivers. Anthropogenic disturbances created other habitats within the park such as rights-of way, roads, trails, canals, ponds, rock walls, and agricultural fields. Signs of historic disturbance are also evident by the large number of old road cuts and abandoned buildings or structures.

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park that were covered with agricultural fields or maintained as fields showed no species of amphibians or reptiles. Mixed deciduous forests or aquatic habitats located within the forest showed the highest number of species. At least 2 stock ponds were located within the park boundary. One pond was adjacent to a field on Bolivar Heights, the other in a forested ravine on Maryland Heights. The Bolivar Heights pond, although mostly filled with silt, contained a population of fishes which reduce the potential amphibian species able to utilize this pond for breeding. No fish were observed in the Maryland Heights pond. This pond supported a wide variety of amphibians and at least one snake species. A higher diversity of species was observed at this site than any other area in the park. The canals and rivers within the park support a variety of amphibians and turtle species. Pond and slack water turtles such as Painted turtles (*Chrysemys picta*), and Snapping turtles (*Chelydra serpentina*), were frequently observed in the canals and other pond-like back waters and scour depressions along the rivers. Floodplains of both large rivers contained few amphibian and reptile species although, flood scour depressions and other ephemeral pools located on the floodplain were used as breeding areas for several frog and salamander species. Small intermittent streams draining through the park are also important habitats for several plethodontid salamander species. These shady moist habitats were inhabited by salamanders and during the dry summer, small still pools were refugia for several frog species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. A diversity of salamander species from 3 taxonomic families was found. One species from Family Salamandridae, 2 species of Ambystomatidae, and 8 species of Plethodontidae were located. The 1 species of Salamandridae, Red-spotted Newt (*Notophthalmus viridescens*), was observed in the pond on Maryland Heights. Habitat for this species is located throughout HAFE in the form of ponds such as those found associated with Quigley Lake and the canal. Ambystomatidae or mole salamanders were observed as egg masses or larvae in an ephemeral pool along the Shenandoah River and in the pond at Maryland Heights. Park personnel reported observing Spotted Salamanders crossing Shoreline Drive towards the canal during spring rains. These species are not always commonly observed as adults, but the egg masses persist in breeding pools and can be identified by their color, size and shape. One species of *Ambystoma* that was not observed was the Marbled Salamander (*Ambystoma opacum*). This species is a secretive fossorial species that breeds in the fall. Its larvae persist through the winter and spring and are often found in the same pools as other ambystomatid species. Although suitable habitat was observed within the park, extensive dipnet surveys produced no Marbled Salamander larvae.

The most diverse group of salamanders observed was the plethodontids, or lungless salamanders. This family can be roughly divided into groups based on habitat use: woodland salamanders and stream salamanders. Two woodland salamanders were observed Red-backed Salamander (*Plethodon cinereus*), and Valley and Ridge Salamander (*P. hoffmani*). Three species of stream salamanders were found. Small fishless streams are ideal habitat for many species of salamanders. Northern Dusky Salamanders (*Desmognathus fuscus*), Northern Two-lined Salamanders (*Eurycea bislineata*) and Northern Spring Salamanders (*Gyrinophilus porphyriticus*) were found in 1st order streams or pond edges where water leaves or enters. Most shaded clean streams in the park and surrounding area should support these salamanders. The stream salamanders and their larvae are the top predators in these fishless streams. One



Seal Salamander (*Desmognathus monticola*) was captured on Maryland Heights from the stream adjacent to the pond. This salamander was covered with wart-like lesions not found in normal healthy individuals. The cause or potential health problems associated with this affliction is unknown. It is also not know if this is widespread in salamanders in this drainage. Further investigation should be done to examine the extent of this potential problem. Long-tailed Salamanders (*Eurycea longicauda*) often inhabit riparian areas and hillsides adjacent to water. This species is often less abundant than *E. bislineata* and may be less tolerant of pollution or disturbance. Habitat for this species is similar to that of Two-lined Salamanders. The ranges of two wetland salamander species, Northern Red Salamanders (*Pseudotriton ruber*) and Four-toed Salamanders (*Hemidactylium scutatum*) are within HAFE. One Northern Red Salamander was observed around the edge of the pond located on Maryland Heights, but Four-toed Salamanders (*Hemidactylium scutatum*) were not found. Both species can be located along the edges of wetlands where they forage or deposit eggs. Northern Red Salamanders also inhabit 1st order streams. Female Four-toed Salamanders tend their clutch of eggs for about 2 months and can often be located at the edge of wetlands under vegetation or mosses. Habitat for this species is found in wet areas of the park, especially those with shade and moss at the water's edge.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Northern Spring Peepers (*Pseudacris crucifer*), were the most abundant species observed, they were heard calling in wet areas around the park. The largest numbers were observed in the pond at Bolivar Heights. Several ranid species were observed in ponds, pools and canals. American Bullfrogs (*Rana catesbeiana*), Northern Green Frogs (*Rana melanota*), and Pickerel Frogs (*Rana palustris*) were heard calling in the canal leading to Quigley Lake. Fowler's Toads (*Bufo fowleri*) and Eastern American Toads (*Bufo americanus*) were found breeding in a pool along the Shenandoah river southeast of Quigley Lake. American Toads will also breed in many temporary shallow pools and puddles. Juvenile Green Frogs were observed in the small stream draining the ravine below the visitor

center, Green Frog tadpoles were also observed in the small stock ponds on Maryland Heights and Bolivar Heights.

Three species whose ranges overlap the park that were not observed were Gray Treefrogs (*Hyla versicolor*), Eastern Cricket Frogs (*Acris c. crepitans*) and Eastern Spadefoots (*Scaphiopus holbrookii*). Suitable habitats for Gray Treefrogs were found in the park but although this is normally a vocal frog, none was heard during inventory visits. No quality Eastern Cricket Frog (*Acris c. crepitans*) or Upland Chorus Frog (*Pseudacris f. feriarum*) habitat was found in the park. Extensive searching for Eastern Cricket Frogs and Upland Chorus Frogs in the surrounding areas of West Virginia in another study showed no populations of these 2 frogs in the immediate area. Although no Spadefoots were found, this species is fossorial and only emerges when environmental conditions are suitable. Therefore, it is probably unlikely that the Spadefoots would be found during this study even if they are present within the park boundaries.

Turtles

Figure 4 shows the distribution of turtles observed in the study. Most turtles observed were in the canals or the rivers. Most pond-dwelling species such as Snapping Turtles (*Chelydra serpentine*) and Painted Turtles (*Chrysemys picta*) were found in the canals and Quigley Lake. Red-bellied Cooters (*Pseudemys rubriventris*) were found in the Shenandoah River and they are found upstream and downstream of HAFE in the Potomac River. Habitat for Eastern Box Turtles (*Terrapene c. carolina*) was found throughout the park. One Wood Turtle (*Glyptemys insculpta*) was found close to Dam 3 and habitat for this animal was found long the floodplains of both rivers.

The range of Red-eared Sliders (*Trachemys s. elegans*) comes close to the park but no individuals were observed in the park or surrounding areas. This is a turtle that was commonly introduced by the pet trade and has become locally established in many areas and therefore may not be a potential species for the park. No habitat for Spotted Turtles (*Clemmys guttata*) was observed within the park although the park is within the range. Harper's Ferry is on the edge of the range for Stinkpots (*Sternotherus odoratus*). Stinkpots have been observed in West Virginia in areas close to Harper's Ferry (Green

and Pauley 1987). This species is probably in HAFE but was not trapped in this study. Habitat for this species is both the rivers and canals.

A major concern for the management of turtle species is the road kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to bury their eggs in loose soil above the normal high water levels. Often these areas are across or along road edges close to water; park personnel can take notice of dead turtles in these areas in early to mid summer. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations.

Lizards

Figure 5 shows the distribution of lizards observed within the park boundaries. There were 2 species of lizards found and both were observed on the dry ridges of Maryland Heights. Conspicuously absent from the list were the Five-lined Skinks (*Eumeces fasciatus*). Habitat for this species and that of other skinks is found throughout the park. Eastern Six-lined Racerunners (*Aspidoscelis s. sexlineata*) were not observed in the park but there are known populations upstream of the HAFE. The closest known population is near Paw Paw, West Virginia.

Snakes

The distribution of snakes observed within HAFE is shown in Figure 6. Habitat for snakes is found throughout the park. The majority of snakes were observed on ridge tops along rights-of-way or edges of roadways. Most snakes observed were in the Maryland Heights or Loudoun Heights areas. Several species of snakes not observed are rare in this area or the near the edge of their range, viz., Eastern Kingsnakes (*Lampropeltis g. getula*) and Red Corn Snakes (*Elaphe guttata*). Rattlesnakes (*Crotalus horridus*) were not observed, but HAFE is well within their range and habitat for the species is located on Maryland Heights and Loudoun Heights. Previous human activities may have extirpated or reduced the numbers of Rattlesnakes in this area, but there is reason to believe they could be in the park. One species of venomous snake, Northern Copperhead (*Agkistrodon c. mokasen*), was observed along the right-of-way on Maryland

Heights. Habitat for this species is found throughout the park. Two non-venomous species, Common Watersnake (*Nerodia s. sipedon*) and Eastern Milksnake (*Lampropeltis t. triangulum*), often confused with the Copperhead were also observed. Although Common Watersnakes are found mostly around water, they often venture distances onto land. Eastern Milksnakes can have colored bands ranging in color from brown to red. The brown-banded color morphs are often mistaken for Copperheads. Habitats for both species are found throughout the park. Of the two Greensnakes of the area, only the Smooth Greensnake was observed. Smooth Greensnake habitat is located on the ridges of Maryland Heights and Loudoun Heights. HAFE is close to an edge of the known distribution of Rough Greensnakes, this species is often observed on vegetation close to water (Plummer 1997). Habitat for this species is found throughout the park, but this species may be just out of its known historic distribution. The abundance of this species may also be in decline. Eastern Ribbonsnakes and Queen Snakes are species associated with wetlands and waterways. Habitats for both these species are found along the canals and rivers in the park, but neither was observed. Northern Black Racers were not observed in the park, but HAFE is within the range of this species and habitat was found throughout the park. This species is often found in transition zones of field and forest habitats, road edges, rights-of-way and other disturbed areas. No species of snake was found in abundance in the park. Many of the larger species were less common here than in other areas of West Virginia. Ratsnakes and Racers frequently fall victim to vehicular traffic while crossing or basking on roads. The large number of roads and high traffic may contribute to the low number of these species observed.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitat for amphibians is often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water,

especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing the parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential Species in Harper's Ferry National Historical Park

AMPHIBIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog
Hyla versicolor – Eastern Gray Treefrog*
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog
Family Pelobatidae
Scaphiopus holbrookii – Eastern Spadefoot
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma jeffersonianum – Jefferson Salamander
Ambystoma maculatum – Spotted Salamander
Ambystoma opacum – Marbled Salamander
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander
Desmognathus monticola – Seal Salamander
Eurycea bislineata – Northern Two-lined Salamander
Eurycea l. longicauda – Long-tailed Salamander
Gyrinophilus p. porphyriticus – Northern Spring Salamander
Hemidactylium scutatum – Four-toed Salamander
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon glutinosus – Northern Slimy Salamander
Plethodon hoffmani – Valley and Ridge Salamander
Pseudotriton r. ruber – Northern Red Salamander
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft

REPTILES
Order Testudines
Family Chelydridae
Chelydra s. serpentina – Eastern Snapping Turtle
Family Emydidae
Chrysemys p. picta – Eastern Painted Turtle
Glyptemys insculpta – Wood Turtle

Pseudemys rubriventris – Northern Red-bellied Cooter
Terrapene c. carolina – Eastern Box Turtle
Trachemys scripta elegans – Red-eared Slider

Family Kinosternidae

Kinosternon subrubrum – Eastern Mud Turtle
Sternotherus odoratus -- Stinkpot

Order Squamata

Suborder Lacertilia

Family Phrynosomatidae

Sceloporus undulatus – Eastern Fence-Lizard

Family Scincidae

Eumeces fasciatus – Common Five-lined Skink*
Eumeces laticeps – Broad-headed Skink

Family Teiidae

Aspidoscelis s. sexlineata – Eastern Six-lined Racerunner

Suborder Serpentes

Family Colubridae

Carphophis a. amoenus – Eastern Wormsnake
Coluber c. constrictor – Northern Black Racer*
Diadophis punctatus edwardsii – Northern Ring-necked Snake
Elaphe g. guttata – Cornsnake
Elaphe o. obsoleta – Black Ratsnake
Heterodon platirhinos – Eastern Hog-nosed Snake*
Lampropeltis g. getula – Eastern Kingsnake
Lampropeltis t. triangulum – Eastern Milksnake
Nerodia s. sipedon – Common Watersnake
Opheodrys a. aestivus – Northern Rough Greensnake
Regina septemvittata – Queen Snake
Storeria d. dekayi – Northern Brownsnake
Storeria o. occipitomaculata – Northern Red-bellied Snake
Thamnophis s. sauritus – Common Ribbonsnake
Thamnophis s. sirtalis – Eastern Gartersnake
Virginia v. valeriae – Eastern Smooth Earthsnake

Family Viperidae

Agkistrodon contortrix mokasen – Northern Copperhead
Crotalus horridus – Timber Rattlesnake*

Underline denotes species found during this study
* Literature Record
** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2. Species observed by habitat at HAFE

Scientific Name	Number	Common Name	Deciduous Forest	Road	Riparian	Boulder Field	Right-of-way	Floodplain	Beaver Dam	Towpath	Wetland	Pond	River	Stream	Ephemeral pool	Permanent Pool	Oxbow Pool
Frogs and Toads																	
Bufo a. americanus	6	Eastern American Toad					X	X							X		
Bufo fowleri	4	Fowler's Toad			X						X						
Pseudacris c. crucifer	6	Northern Spring Peeper										X					
Rana c. melanota	6	Northern Green Frog									X	X					
Rana catesbeiana	3	American Bullfrog									X	X			X		
Rana palustris	2	Pickerel Frog	X														
Rana sylvatica	2	Wood Frog										X					
Salamanders																	
Ambystoma jeffersonianum	1	Jefferson Salamander															X
Ambystoma maculatum	4	Spotted Salamander										X					X
Desmognathus fuscus	17	Northern Dusky Salamander	X		X									X			
Desmognathus monticola	1	Seal Salamander												X			

Scientific Name	Number	Common Name	Deciduous Forest	Road	Riparian	Boulder Field	Right-of-way	Floodplain	Beaver Dam	Towpath	Wetland	Pond	River	Stream	Ephemeral pool	Permanent Pool	Oxbow Pool
Eurycea bislineata	8	Northern Two-lined Salamander	X									X					
Eurycea longicauda	1	Long-tailed Salamander	X														
Gyrinophilus p. porphyriticus	3	Northern Spring Salamander										X					
Notophthalmus v. viridescens	2	Red-spotted Newt										X					
Plethodon cinereus	12	Eastern Red-backed Salamander	X									X					
Plethodon hoffmani	2	Valley and Ridge Salamander	X									X					
Pseudotriton r. ruber	1	Northern Red Salamander										X					
Lizards																	
Eumeces laticeps	2	Broad-headed Skink	X				X										
Sceloporus undulatus	7	Eastern Fence Lizard	X			X											

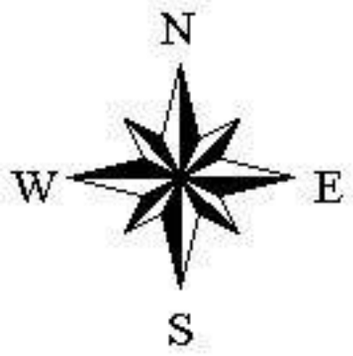
Scientific Name	Number	Common Name	Deciduous Forest	Road	Riparian	Boulder Field	Right-of-way	Floodplain	Beaver Dam	Towpath	Wetland	Pond	River	Stream	Ephemeral pool	Permanent Pool	Oxbow Pool
Snakes																	
Agkistrodon c. mokasen	1	Northern Copperhead					X										
Carphophis a. amoenus	1	Eastern Wormsnake				X											
Diadophis p. edwardsii	7	Northern Ring-necked Snake	X				X										
Elaphe o. obsoleta	2	Black Ratsnake		X													
Lampropeltis t. triangulum	2	Eastern Milksnake	X								X						
Nerodia s. sipedon	2	Common Watersnake										X	X				
Opheodrys a. aestivus	1	Northern Rough Greensnake	X														
Thamnophis s. sirtalis	3	Eastern Gartersnake	X							X							
Turtles																	
Chelydra s. serpentina	7	Eastern Snapping Turtle							X		X	X	X				
Chrysemys p. picta	6	Eastern Painted Turtle							X							X	
Glyptemys insculpta	1	Wood Turtle							X								

Oxbow Pool		
Permanent Pool		
Ephemeral pool		
Stream		
River	X	
Pond		
Wetland		
Towpath		
Beaver Dam		
Floodplain		
Right-of-way		
Boulder Field		
Riparian		X
Road		
Deciduous Forest		X
Common Name	Northern Red-bellied Cooter	Eastern Box Turtle
Number	5	5
Scientific Name	*Pseudemys rubriventris*	*Terrapene c. carolina*

Table 3. Summary of inventory results for HAFE

Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	14	11	79
Toads	3	2	67
Frogs	8	5	63
Turtles	8	5	63
Lizards	4	2	50
Snakes	18	8	45

Harpers Ferry National Historic Park



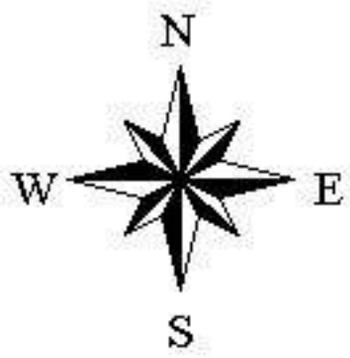


Habitat Types

- Beaver Dam
- Boulder Field
- Deciduous Forest
- Ephemeral Pool
- Ephermal Pool
- Floodplain
- Highway
- Oxbow Pool
- Permanent Pool
- Pond
- Right-of-Way
- Riparian
- River
- Stream
- Towpath
- Wetland
- Park Boundary

map by MBW April 2005

Harpers Ferry National Historic Park



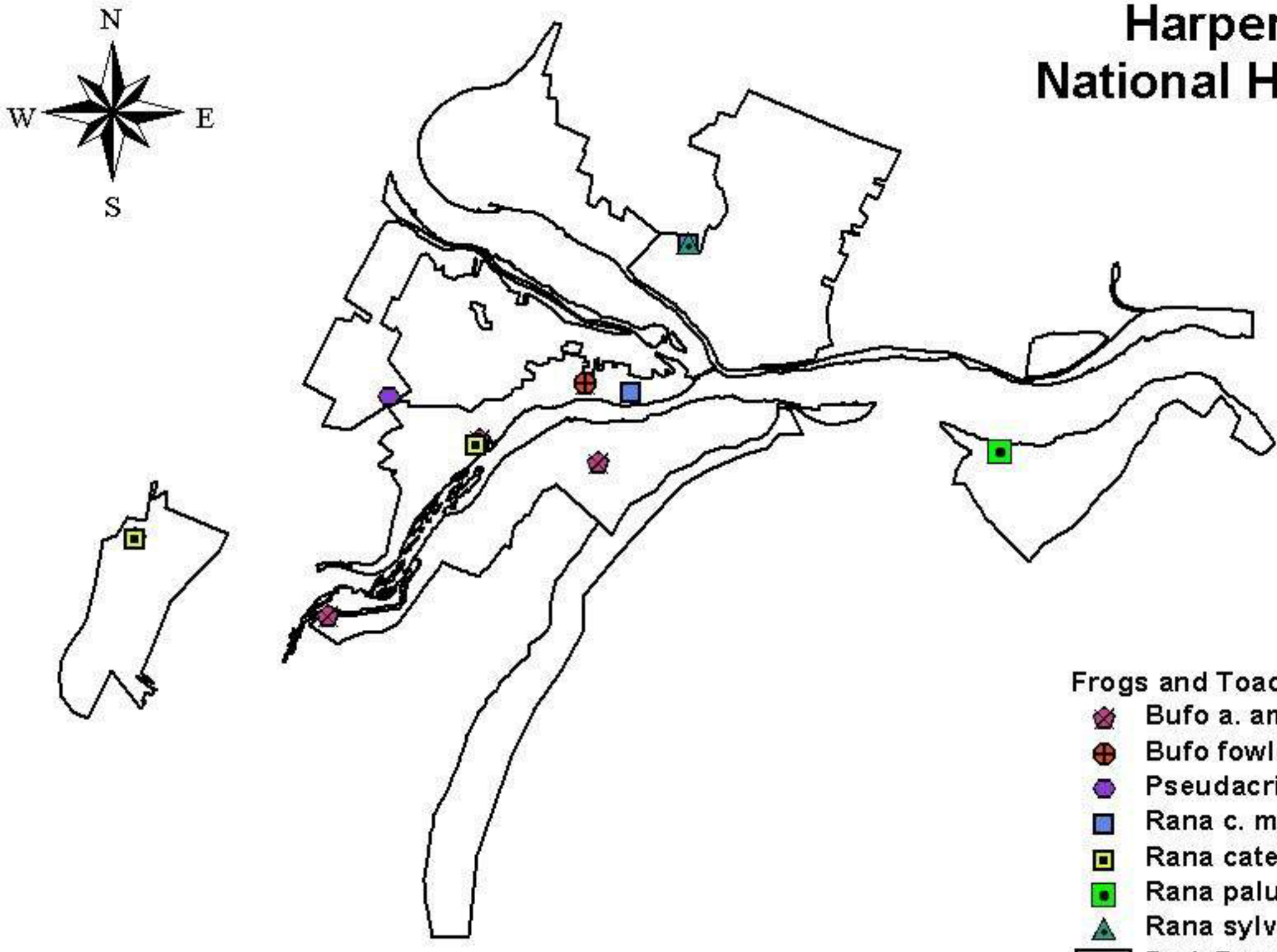
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Salamanders

- Ambystoma jeffersonianum
- Ambystoma maculatum
- Desmognathus fuscus
- Desmognathus monticola
- Eurycea bislineata
- Eurycea longicauda
- Gyrinophilus p. porphyriticus
- Notophthalmus v. viridescens
- Plethodon cinereus
- Plethodon hoffmani
- Pseudotriton r. ruber
- Park Boundary

map by MBW April 2005

Harpers Ferry National Historic Park



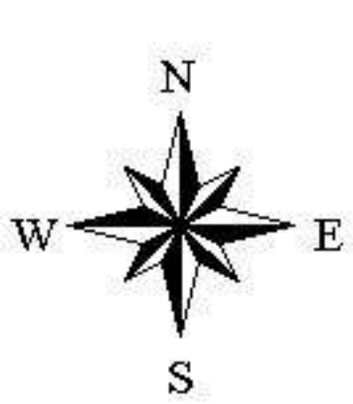
Frogs and Toads

- Bufo a. americanus
- Bufo fowleri
- Pseudacris c. crucifer
- Rana c. melanota
- Rana catesbeiana
- Rana palustris
- Rana sylvatica
- Park Boundary

2 0 2 4 Kilometers

map by MBW April 2005

Harpers Ferry National Historic Park



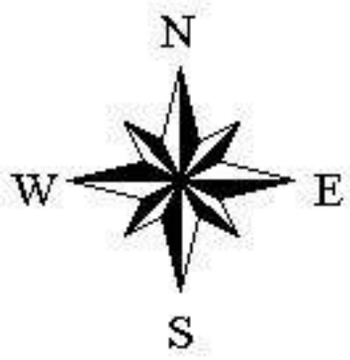
Lizards
- Eumeces laticeps
- Sceloporus undulatus

Park Boundary

2 0 2 4 Kilometers

map by MBW April 2005

Harpers Ferry National Historic Park



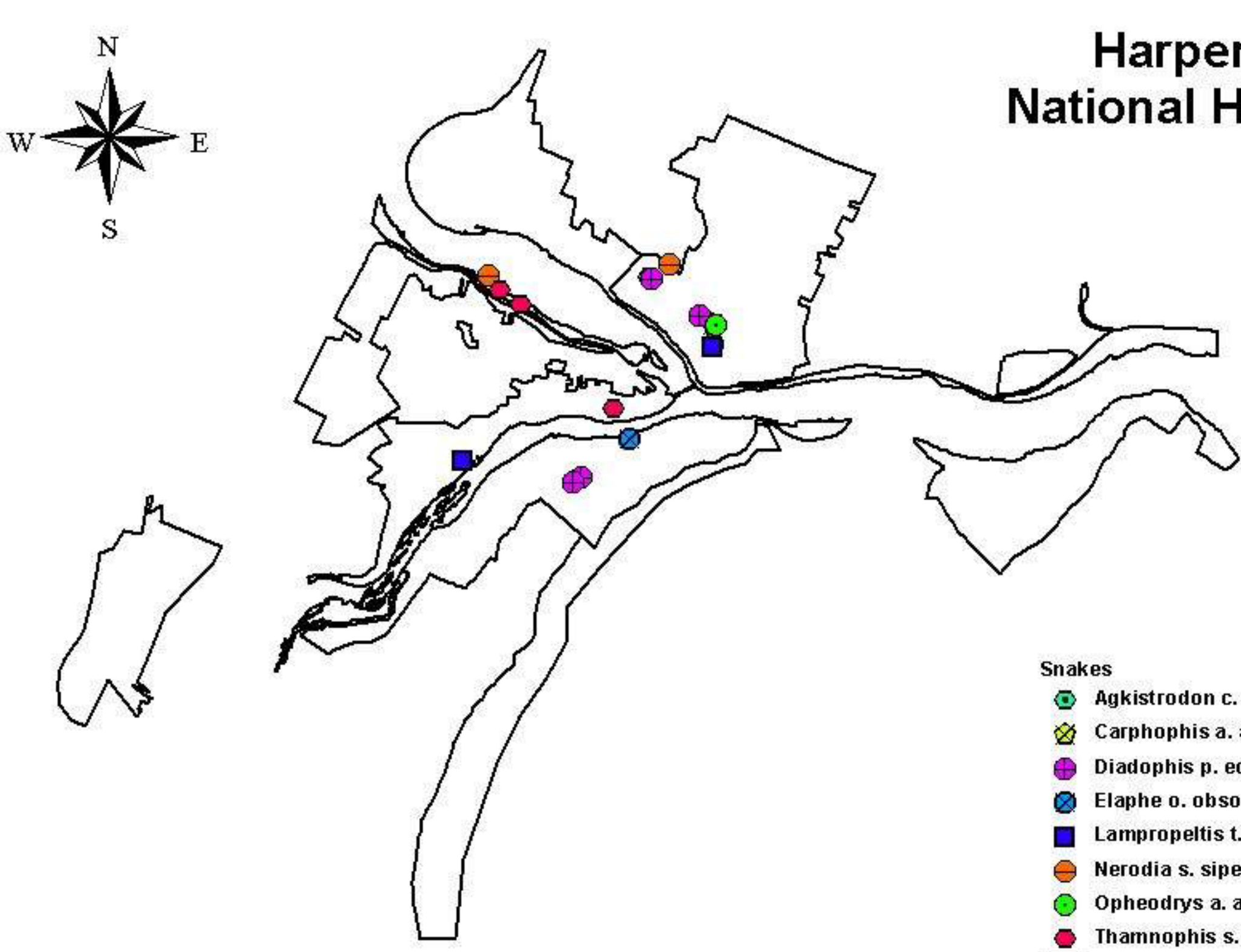
Turtles
- Chelydra s. serpentina
- Chrysemys p. picta
- Glyptemys insculpta
- Pseudemys rubriventris
- Terrapene c. carolina

Park Boundary

2 0 2 4 Kilometers

map by MBW April 2005

Harpers Ferry National Historic Park



Snakes

- Agkistrodon c. mokasen
- Carphophis a. amoenus
- Diadophis p. edwardsii
- Elaphe o. obsoleta
- Lampropeltis t. triangulum
- Nerodia s. sipedon
- Opheodrys a. aestivus
- Thamnophis s. sirtalis
- Park Boundary

2 0 2 4 Kilometers

map by MBW April 2005

APPENDIX 6

REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

MANASSAS BATTLEFIELD PARK

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Figure 3. Distribution of frog and toad species

Figure 4. Distribution of turtle species

Figure 5. Distribution of lizard species

Figure 6. Distribution of snake species

Introduction

Manassas National Battlefield Park (MANA) is an approximately 5000-acre park preserving the site of 2 Civil War battlegrounds and associated monuments. The park in the located just north of Manassas, Virginia and is comprised of mostly open fields with hardwood and pine forests. Dr. Joseph C. Mitchell and his associated field technicians from University of Richmond, VA and Drs. Thomas K. Pauley and Mark B. Watson and graduate students from the Department of Biological Sciences at Marshall University, Huntington conducted inventories.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of MANA (Kelly et al. 1936; McCauley 1945; Linzey and Gifford 1981; Tobey 1985; Conant and Collins 1998; Ernst et al. 1994; Mitchell 1994; Mitchell and Reay 1999; Petranka 1998). A site reconnaissance was done on the initial visit and after council with MANA personnel we identified habitats for target species. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1.

before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data was recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of MANA and their habitats were located by field reconnaissance are listed in Table 1. Fifty-two species had distributions that overlapped the boundaries of MANA. The list of potential species is a conservative list used to guide investigation in this study and future studies.

Species Summary

A summary of species observed during field inventories of MANA is listed in Table 2. Nine species of frogs, 2 species of toads, 4 species of salamanders, 2 species of lizards, 10 species of snakes and 5 species of turtles were observed. Several potential species were not observed, but their occurrence in the park cannot be ruled out. Some of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventory techniques, such as drift fences combined with pitfall traps, to identify their presence.

Data in Table 3 compare the number of potential species with the number of species found for each group. Most species unaccounted for were species where MANA was located on the edge of their geographic distribution or habitat within the park was marginal.

Habitats

MANA is unique among the Capitol Region parks for its many diverse habitats, several created by human inhabitants. Approximately half the land cover is devoted to agriculture or related uses and the rest is divided up among different forest types. Oak-Hickory forests characterize much of the upland forest, which in the northern piedmont of Virginia is being rapidly degraded by habitat destruction by land developers. Housing developments, a large golf course and a multi-lane highway surround the park. Several

wetland types are located within the park including the riparian floodplain areas of Young's Branch and Bull Run. In addition several wet meadows are located close to the historic Brawner House and other low areas of the park.

The understory and herbaceous layers were often dominated in many areas by exotic invasive species, especially in the low areas and field edges. Anthropogenic disturbances created other habitats within the park such as rights-of way, roads, trails, canals, ponds, rock walls, and agricultural fields. Signs of historic disturbance are also evident by several old road cuts and abandoned buildings or structures. Although these disturbances create varied habitats and potentially increase species diversity, they nonetheless can fragment some habitats.

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park that were covered with agricultural fields or maintained as fields reptiles. Mixed deciduous forests or aquatic habitats located within the forest had the highest number of species. Painted turtles (*Chrysemys picta*), and Snapping turtles (*Chelydra serpentina*), were frequently observed in the farm ponds or pond-like backwaters and scour depressions along the creeks. Floodplains forests contained few amphibian and reptile species although, flood scour depressions and other ephemeral pools located on the floodplain were used as breeding areas for several frog and salamander species. Small intermittent streams running through the park are also important habitats for several plethodontid salamander species. These shady moist habitats were inhabited by salamanders and during the dry summer, small still pools were refugia for several frog species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. Salamander species from 3 taxonomic families (Salamandridae, Ambystomatidae, and Plethodontidae) were found. The 1 salamandrid, Red-spotted Newt (*Notophthalmus viridescens*), was observed in wetlands and permanent pools of standing water. Habitat for this species is located throughout MANA in the form of ponds, wetlands and other areas where water persists throughout the year. Spotted Salamander (*Ambystoma maculatum*) egg masses and larvae were found in an ephemeral pool along the

floodplains. One species of *Ambystoma* not observed that may be present is the Marbled Salamander (*Ambystoma opacum*). This is a fossorial species that breeds in the fall. Its larvae persist through the winter and spring and are often found in the same pools as other ambystomatid species. Although suitable habitat was observed within the park, extensive dipnet surveys produced no Marbled Salamander larvae. Park managers should note their presence or absence.

The other group of salamanders observed was the plethodontids, or lungless salamanders. This family can be roughly divided into groups based on habitat use: woodland salamanders and stream salamanders. A majority of woodland salamanders are found in mesic upland forests. Only one woodland salamander was observed, Red-backed Salamander (*Plethodon cinereus*). White-spotted Slimy Salamanders (*Plethodon cylindraceus*) are often found on shaded rocky hillsides in well-drained soils. They could occur in the park but their habitat is not abundant in MANA. The only species of stream salamander found was the Northern Two-lined Salamander (*Eurycea bislineata*). Small cool, fishless streams are ideal habitat for many species of salamanders. The stream salamanders and their larvae are the top predators in these fishless streams. Northern Dusky Salamanders (*Desmognathus fuscus*), Northern Two-lined Salamanders (*Eurycea bislineata*), and Eastern Three-lined Salamanders (*Eurycea guttolineata*) are often found in 1st order streams or pond edges where water leaves or enters. The adults of these species are often found along riparian zones or under cover objects in the stream. *Eurycea* larvae often persist for multiple years and are dependent on clean water with adequate oxygen supply. The low abundance of stream salamanders may indicate some water quality issues.

The range of Northern Red Salamanders (*Pseudotriton ruber*) overlaps MANA but none was located. Northern Red Salamanders can be located along the edges of wetlands and 1st order streams where they forage or deposit eggs.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Although salamander habitat is limited in MANA, frog and toad habitat is abundant. All potential species of toads and frogs except Southern Leopard Frogs (*Rana sphenocephala*

utricularia) and were found. Breeding areas of toads and frogs include ponds, permanent or ephemeral pools, flood scours, and wetlands with some standing water. Tree frog species such as Northern Spring Peepers (*Pseudacris crucifer*), Upland Chorus Frogs (*Pseudacris feriarum*) and Gray Treefrogs (*Hyla chrysoscelis and H. versicolor*) were heard calling in wet areas around the park. Habitats for Eastern Cricket Frogs (*Acris c. crepitans*), Bullfrogs (*Rana catesbeiana*), Green Frogs (*Rana melanota*), Wood Frogs (*Rana sylvatica*) and Pickerel Frogs (*Rana palustris*) were observed in areas of the park with ponds or stream pools. Fowler's Toads (*Bufo fowleri*) and Eastern American Toads (*Bufo americanus*) were found breeding in ephemeral pools throughout the park. Both toads will also breed in many temporary shallow pools and puddles.

Turtles

Figure 4 shows the distribution of turtles observed in the study. Habitat for Eastern Box Turtles (*Terrapene c. carolina*) was found in upland areas throughout the park. Painted Turtles (*Chrysemys picta*) were the most abundant species and along with Eastern Snapping Turtles (*Chelydra s. serpentina*) were found in most aquatic habitats. Aquatic turtle habitat was observed in farm ponds scattered throughout the park and in wetlands at Young's Branch and Bull Run. Red-eared Sliders (*Trachemys s. elegans*) were observed in Portici Pond. This is a turtle that was commonly introduced by the pet trade and has become locally established in many areas, therefore it is difficult to determine natural from feral populations. Stinkpots (*Sternotherus odoratus*) were found in both the creeks and ponds. Habitat for Spotted Turtles (*Clemmys guttata*) was observed within wetlands of the park but specimens were not observed.

A major concern for the management of turtle species is the road-kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to bury their eggs in loose soil above the normal high water levels. Often these areas are across or along road edges close to water; park personnel should take notice of dead turtles in these areas in early to mid-summer. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations.

Lizards

Figure 5 shows the distribution of lizards observed within the park boundaries. There were 2 species of the 5 potential lizards found. Habitats for these species and that of other skinks or lizards are found throughout the park in edges, buildings, fences, or other structures in open areas of the park. The Eastern Fence-Lizard (*Sceloporus undulatus*) was not observed, although habitat for this species is within the park. Skinks and lizards are locally abundant within their ranges and they become inactive when environmental conditions are not optimum.

Snakes

The distribution of the 10 species of snakes observed within MANA is shown in Figure 6. Habitat for snakes is found throughout the park, especially around edges of agricultural fields, road edges or rights-of-way. The majority of Northern Copperheads (*Agkistrodon c. mokasen*) were observed in and around an old junk pile in a field close to the forest edge. Common Watersnakes (*Nerodia s. sipedon*) were observed in Youngs Branch and habitat for this species is also found in Bull Run, ponds and other areas with permanent standing water. Northern Ring-necked Snakes (*Diadophis p. edwardsii*) were abundant in the park and found under cover objects such as flat rocks. Two Eastern Wormsnakes (*Carphophis a. amoenus*) were found, 1 close to the junk pile mentioned previously and the other close to the old house site behind the Enforcement Headquarters. These secretive snakes are found under cover objects, often close to the edges of open areas. An Eastern Hog-nosed Snake (*Heterodon platirhinos*) was observed and habitat was found in the sandy floodplain areas. Northern Black Racers (*Coluber c. constrictor*), Northern Brownsnakes (*Storeria d. dekayi*), Eastern Gartersnakes (*Thamnophis s. sirtalis*) and Black Ratsnakes (*Elaphe o. obsolete*) were found in areas of the park with habitat consisting of transition zones of field and forest habitats, road edges, junk piles, old house sites, rights-of-way and other disturbed areas. Ratsnakes and Racers frequently fall victim to vehicular traffic while crossing or basking on roads. Large numbers of roads and high traffic may contribute to the decline in snake species observed. Of the 3 potential species of *Lampropeltis* in the park only the Mole Kingsnake (*Lampropeltis c.*

rhombomaculata) was observed. A gravid female was found dead on Suoley Road near the Visitors Center and others were found close to wetlands.

MANA is within the distribution of Rough Greensnakes (*Opheodrys aestivus*), this species is often observed on vegetation close to water (Plummer 1997). Habitat for this species is found in the shrub layer throughout the park especially close to the pond and stream. Abundance of this species may be in decline throughout its range. Eastern Ribbonsnakes (*Thamnophis s. sauritus*) and Queen Snakes (*Regina septemvittata*) are species associated with wetlands and waterways. Marginal habitats for both these species are found along the riparian areas in the park, but neither was observed.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitats for amphibians are often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water, especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or the metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing the parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the

forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential species in Manassas Battlefield Park

AMPHIBIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog
Hyla chrysoscelis – Cope's Gray Treefrog
Hyla versicolor – Eastern Gray Treefrog
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog
Rana sphenocephala utricularia – Southern Leopard Frog**
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma maculatum – Spotted Salamander
Ambystoma opacum – Marbled Salamander**
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander
Eurycea bislineata – Northern Two-lined Salamander
Eurycea guttolineata– Three-lined Salamander
Hemidactylium scutatum – Four-toed Salamander
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon cylindraceus – White-spotted Slimy Salamander
Pseudotriton r. ruber – Northern Red Salamander
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft

REPTILES
Order Testudines
Family Chelydridae
Chelydra s. serpentina – Eastern Snapping Turtle
Family Emydidae
Chrysemys p. picta – Eastern Painted Turtle
Clemmys guttata – Spotted Turtle
Pseudemys rubriventris – Northern Red-bellied Cooter
Terrapene c. carolina – Eastern Box Turtle
Trachemys scripta elegans – Red-eared Slider
Family Kinosternidae

Sternotherus odoratus – Stinkpot

Order Squamata

Suborder Lacertilia

Family Phrynosomatidae

Sceloporus undulatus – Eastern Fence-Lizard

Family Scincidae

Eumeces fasciatus – Common Five-lined Skink

Eumeces inexpectatus – Southeastern Five-lined Skink

Eumeces laticeps – Broad-headed Skink

Scincella lateralis – Little Brown Skink

Suborder Serpentes

Family Colubridae

Carphophis a. amoenus – Eastern Wormsnake

Coluber c. constrictor – Northern Black Racer

Diadophis punctatus edwardsii – Northern Ring-necked Snake

Elaphe g. guttata – Cornsnake

Elaphe o. obsoleta – Black Ratsnake

Heterodon platirhinos – Eastern Hog-nosed Snake

Lampropeltis calligaster rhombomaculata – Mole Kingsnake

Lampropeltis g. getula – Eastern Kingsnake

Lampropeltis t. triangulum – Eastern Milksnake

Nerodia s. sipedon – Common Watersnake

Opheodrys a. aestivus – Northern Rough Greensnake

Regina septemvittata – Queen Snake

Storeria d. dekayi – Northern Brownsnake

Storeria o. occipitomaculata – Northern Red-bellied Snake

Thamnophis s. sauritus – Common Ribbonsnake

Thamnophis s. sirtalis – Eastern Gartersnake

Virginia v. valeriae – Eastern Smooth Earthsnake

Family Viperidae

Agkistrodon contortrix mokasen – Northern Copperhead

Underline denotes species found during this study

* Literature Record

** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2 Species observed at MANA

Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Field	Floodplain	Old Building	Old Field	Parking Lot	Permanent Pool	Pond	Right-of-Way	Road	Roadside Ditch	Rock Pile	Stream	Wetland
Frogs and Toads																	
Bufo a. americanus	12	Eastern American Toad		X		X			X					X		X	X
Bufo fowleri	5	Fowler's Toad		X		X											
Acris c. crepitans	8	Eastern Cricket Frog		X							X			X			
Hyla chrysoscelis	9	Cope's Gray Treefrog		X							X					X	
Hyla versicolor	2	Gray Treefrog														X	
Pseudacris c. crucifer	16	Northern Spring Peeper	X	X			X			X	X						X
Pseudacris f. feriarum	33	Upland Chorus Frog		X	X												
Rana c. melanota	8	Northern Green Frog		X						X	X					X	
Rana catesbeiana	4	American Bullfrog		X							X						
Rana palustris	9	Pickerel Frog								X	X			X			X
Rana sylvatica	76	Wood Frog		X		X				X				X		X	X

Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Field	Floodplain	Old Building	Old Field	Parking Lot	Permanent Pool	Pond	Right-of-Way	Road	Roadside Ditch	Rock Pile	Stream	Wetland
Salamanders																	
Ambystoma maculatum	20	Spotted Salamander		**X**						**X**						**X**	**X**
Eurycea bislineata	5	Northern Two-lined Salamander														**X**	
Notophthalmus v. viridescens	4	Red-spotted Newt								**X**							**X**
Plethodon cinereus	1	Eastern Red-backed Salamander			**X**												
Lizards																	
Eumeces fasciatus	2	Common Five-lined Skink			**X**											**X**	
Eumeces laticeps	4	Broad-headed Skink	**X**		**X**											**X**	
Snakes																	
Agkistrodon c. mokasen	6	Northern Copperhead	**X**		**X**		**X**										
Carphophis a. amoenus	2	Eastern Wormsnake	**X**				**X**										

Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Field	Floodplain	Old Building	Old Field	Parking Lot	Permanent Pool	Pond	Right-of-Way	Road	Roadside Ditch	Rock Pile	Stream	Wetland
Coluber c. constrictor	48	Northern Black Racer			X		X										
Diadophis p. edwardsii	11	Northern Ring-necked Snake	X		X	X	X										
Elaphe o. obsoleta	20	Black Ratsnake			X		X					X	X		X		X
Heterodon platirhinos	2	Eastern Hog-nosed Snake			X												
Lampropeltis c. rhombomaculata	5	Mole Kingsnake						X					X				X
Nerodia s. sipedon	2	Common Watersnake									X					X	
Storeria d. dekayi	3	Northern Brownsnake			X												
Thamnophis s. sirtalis	5	Eastern Gartersnake			X							X	X				
Turtles																	
Chelydra s. serpentina	6	Eastern Snapping Turtle									X					X	
Chrysemys p. marginata	1	Midland Painted Turtle									X						

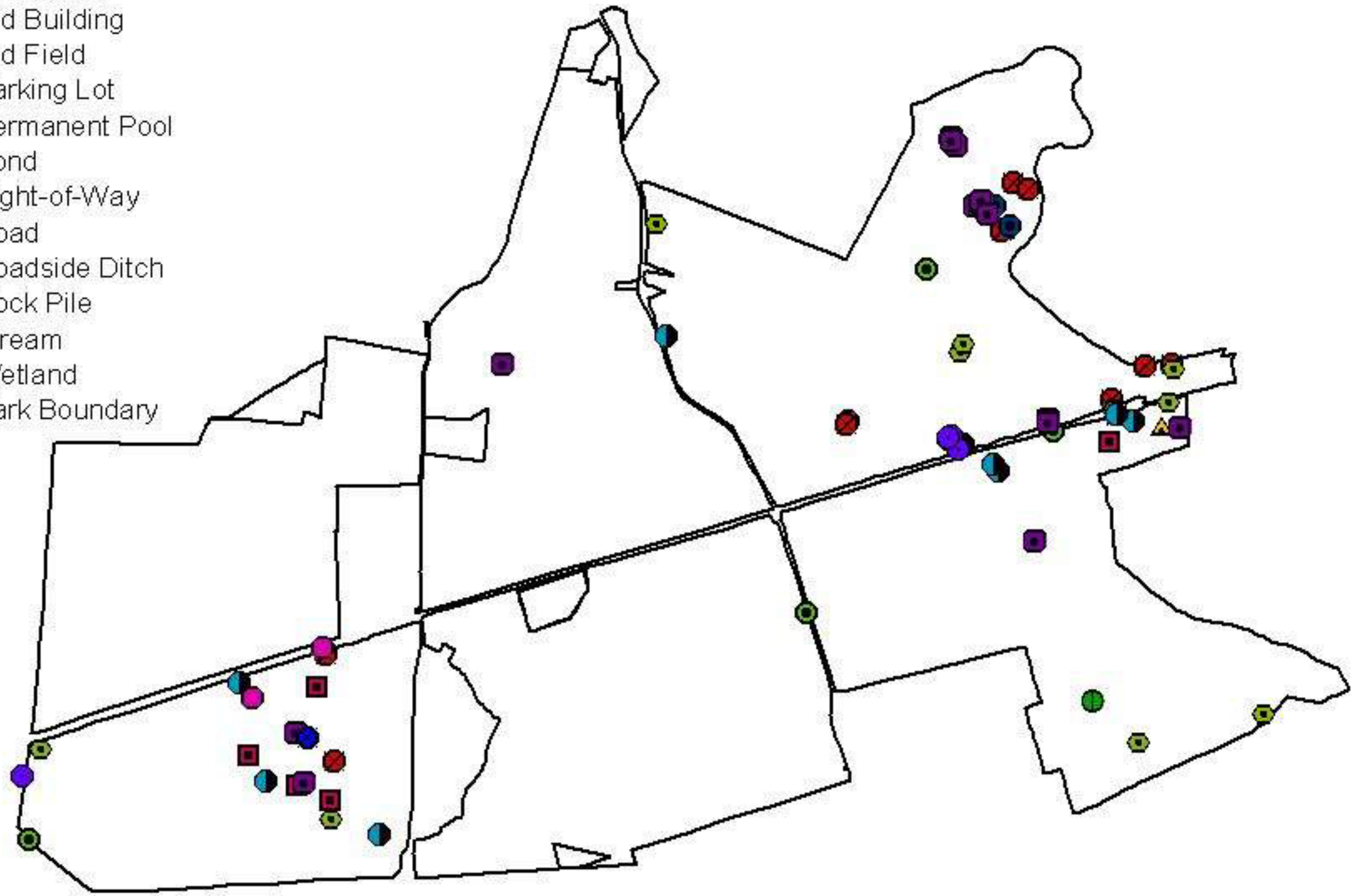
Wetland					
Stream	X				
Rock Pile					
Roadside Ditch					
Road			X		
Right-of-Way			X		
Pond	X	X	X	X	
Permanent Pool	X				
Parking Lot					
Old Field					
Old Building					
Floodplain			X		
Field			X		
Ephemeral Pool			X		
Deciduous Forest					
Common Name	Eastern Painted Turtle	Stinkpot	Eastern Box Turtle	Red-Eared Slider	
Number	113	4	24	7	
Scientific Name	*Chrysemys p. picta*	*Sternotherus odoratus*	*Terrapene c. carolina*	*Trachemys s. elegans*	

Table 3. Summary of inventory results for MANA

Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	10	4	40
Toads	2	2	100
Frogs	10	9	90
Turtles	7	5	72
Lizards	5	2	40
Snakes	18	10	56

Manassas National Battlefield Park
Herpetological Inventory

Habitats
- Deciduous Forest
- Ephemeral Pool
- Field
- Floodplain
- Old Building
- Old Field
- Parking Lot
- Permanent Pool
- Pond
- Right-of-Way
- Road
- Roadside Ditch
- Rock Pile
- Stream
- Wetland
- Park Boundary

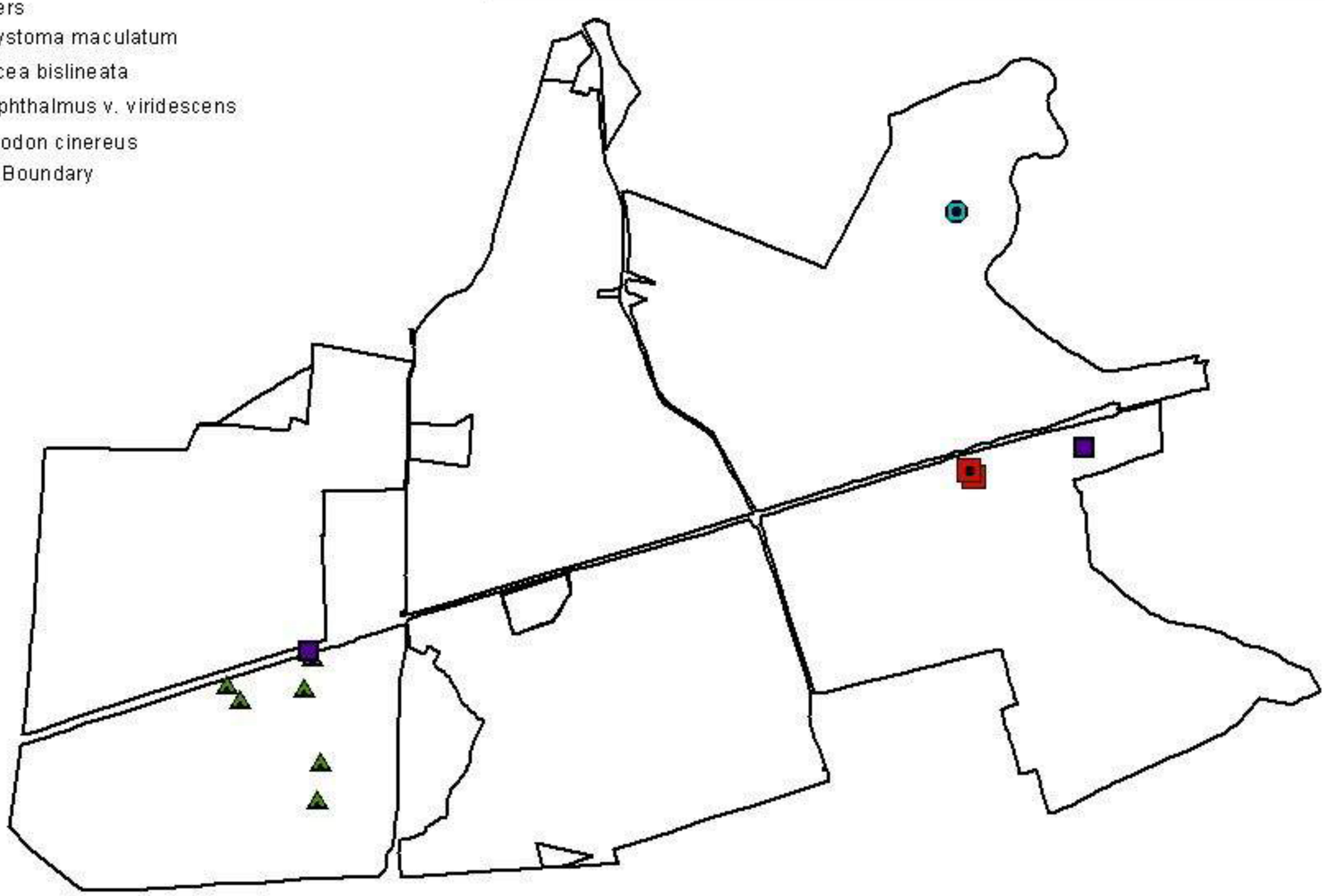


500 0 500 1000 1500 2000 Meters

prepared by: MBW March 1, 2004

Manassas National Battlefield Park
Herpetological Inventory

Salamanders
- Ambystoma maculatum
- Eurycea bislineata
- Notophthalmus v. viridescens
- Plethodon cinereus
- Park Boundary

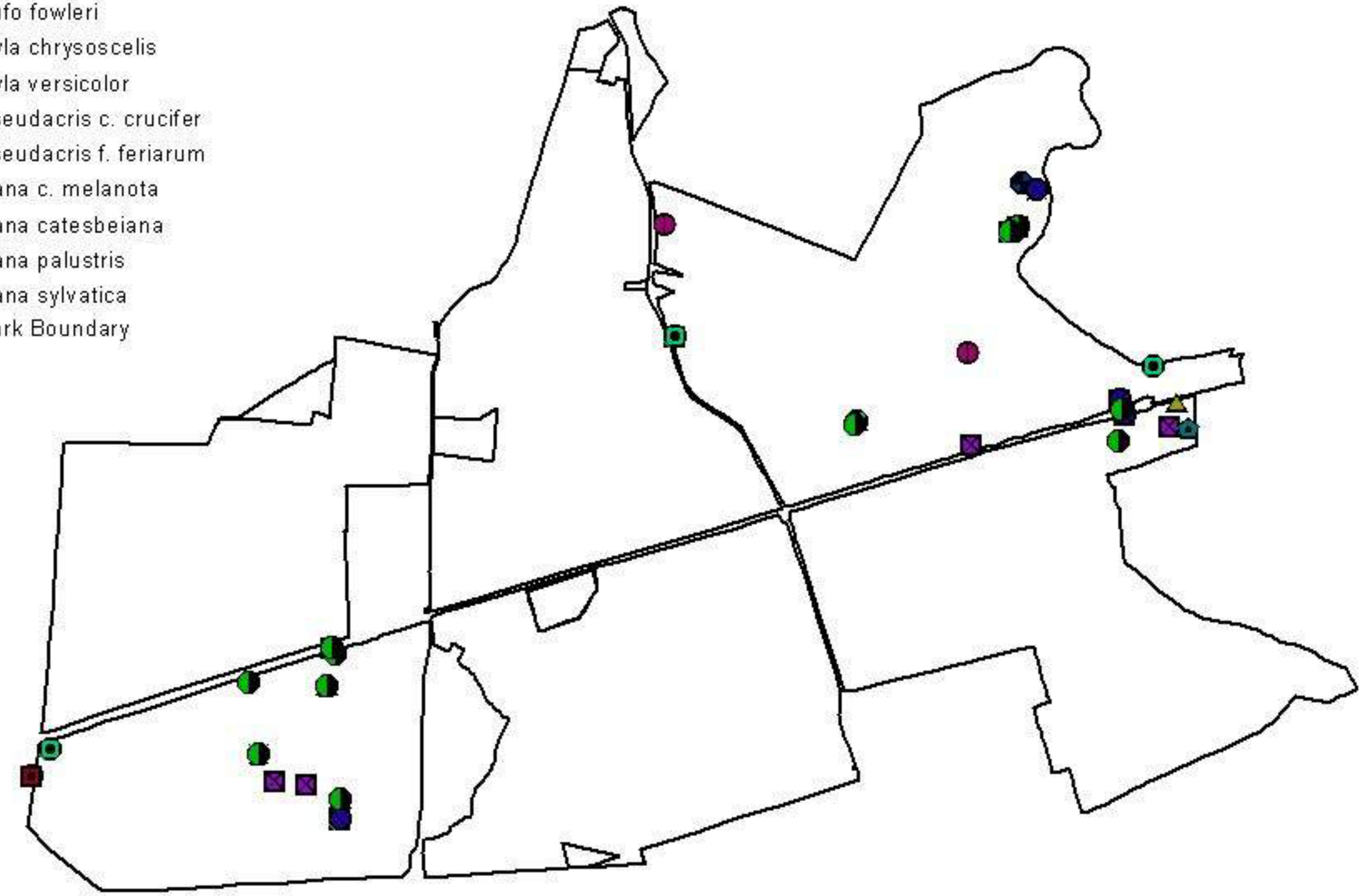


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prepared by: MBW June 1, 2005

Manassas National Battlefield Park
Herpetological Inventory

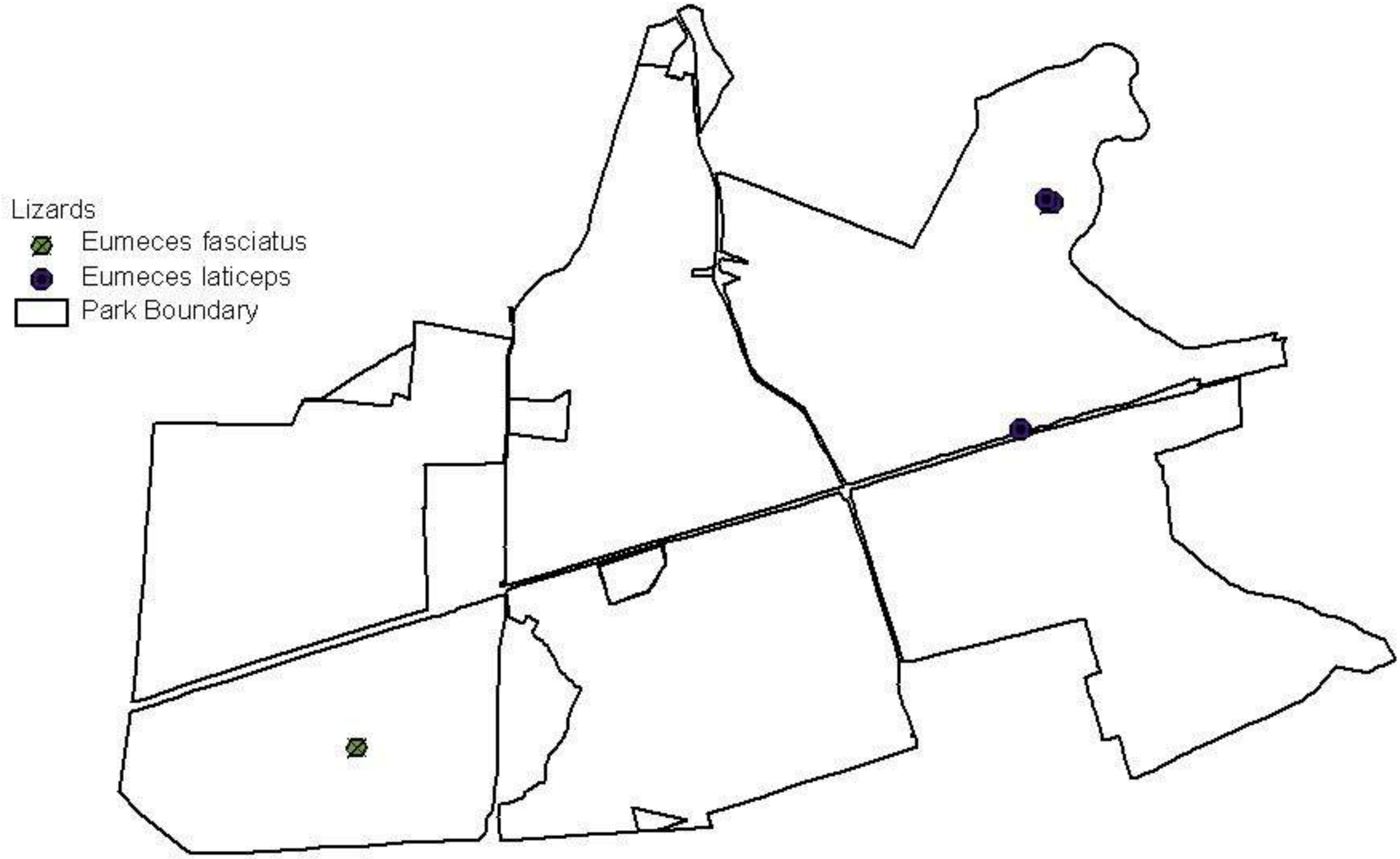
Frogs and Toads
- Acris c. crepitans
- Bufo a. americanus
- Bufo fowleri
- Hyla chrysoscelis
- Hyla versicolor
- Pseudacris c. crucifer
- Pseudacris f. feriarum
- Rana c. melanota
- Rana catesbeiana
- Rana palustris
- Rana sylvatica
- Park Boundary



500 0 500 1000 1500 2000 Meters

prepared by: MBW June 1, 2005

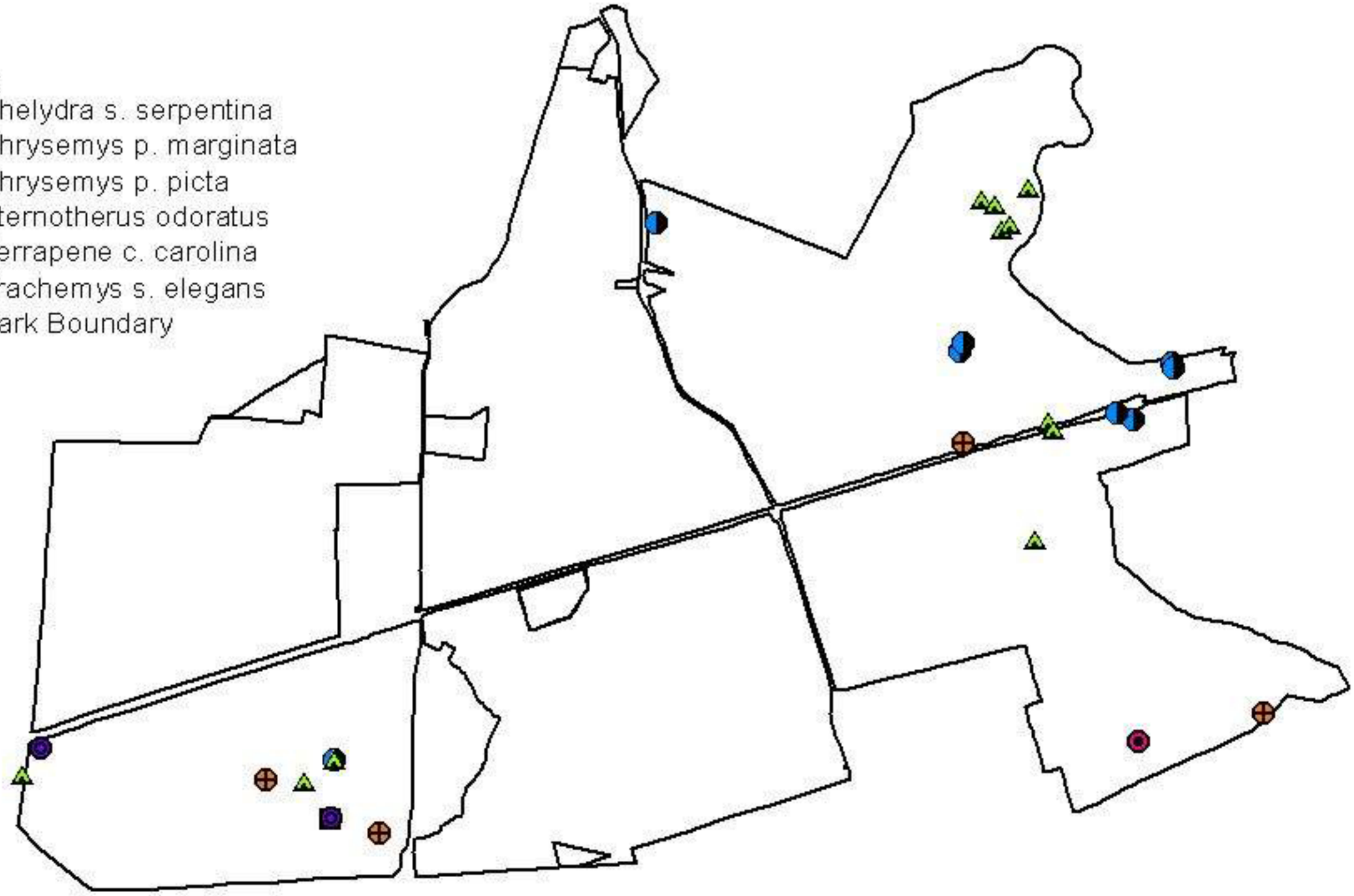
Manassas National Battlefield Park
Herpetological Inventory



prepared by: MBW June 1, 2005

Manassas National Battlefield Park
Herpetological Inventory

Turtles
- Chelydra s. serpentina
- Chrysemys p. marginata
- Chrysemys p. picta
- Sternotherus odoratus
- Terrapene c. carolina
- Trachemys s. elegans
- Park Boundary

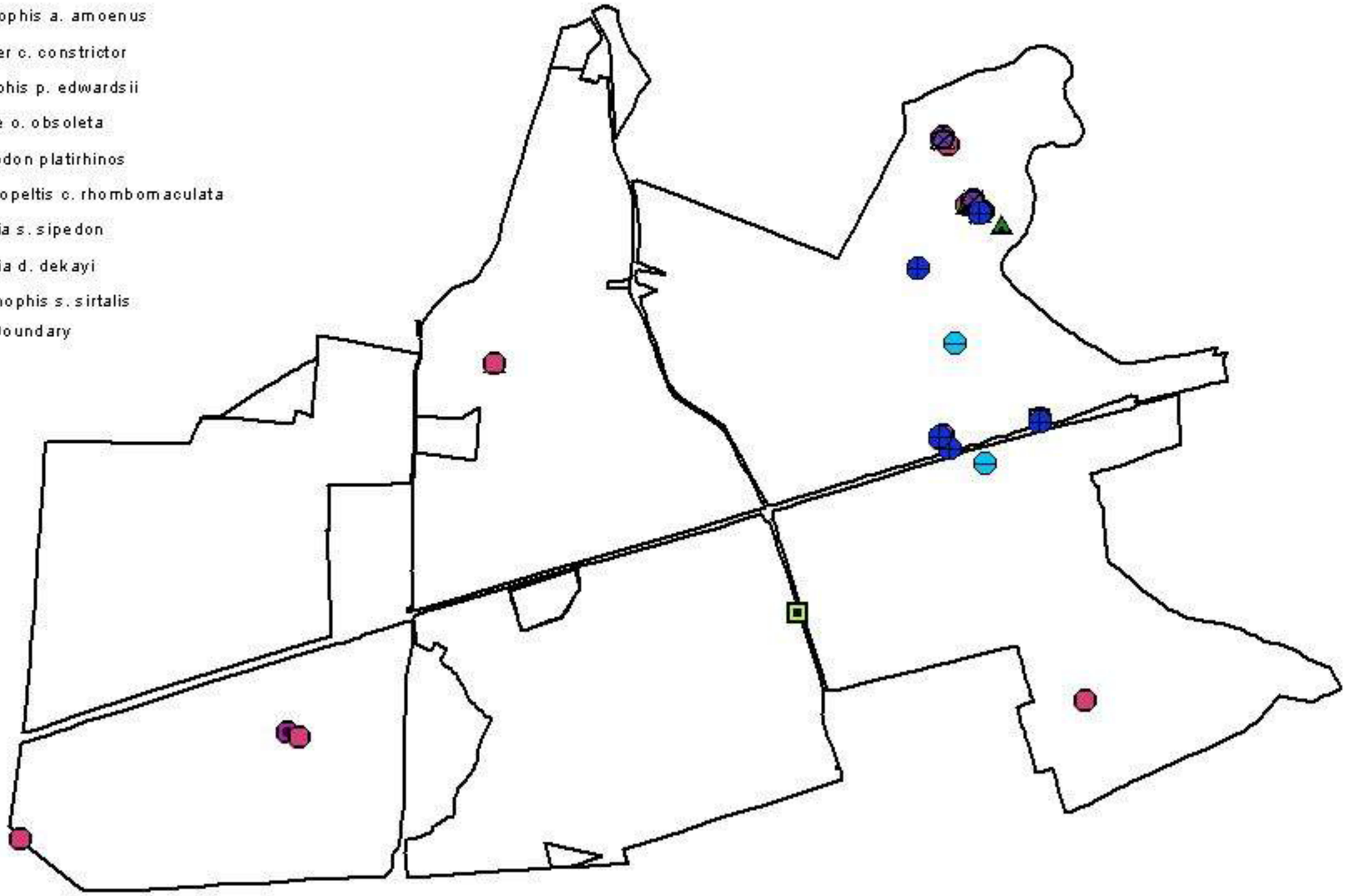


500 0 500 1000 1500 2000 Meters

prepared by: MBW June 1, 2005

Manassas National Battlefield Park
Herpetological Inventory

Snakes
- Agkistrodon c. mokasen
- Carphophis a. amoenus
- Coluber c. constrictor
- Diadophis p. edwardsii
- Elaphe o. obsoleta
- Heterodon platirhinos
- Lampropeltis c. rhombomaculata
- Nerodia s. sipedon
- Storeria d. dekayi
- Thamnophis s. sirtalis
- Park Boundary



500 0 500 1000 1500 2000 Meters

prepared by: MBW June 1, 2005

APPENDIX 7

REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

MONOCACY BATTLEFIELD PARK

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Figure 3. Distribution of frog and toad species

Figure 4. Distribution of turtle species

Figure 5. Distribution of lizard species

Figure 6. Distribution of snake species

Introduction

Monocacy National Battlefield Park (MONO) is an approximately 1700-acre park preserving the site of an important Civil War era battleground and associated monuments. Monocacy was the site of an important battle defending Washington, D.C. This park is situated on the bank of the Monocacy River south of the city of Frederick, MD. Drs. Thomas K. Pauley and Mark B. Watson and graduate students from the Department of Biological Sciences at Marshall University conducted inventories.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of MONO (Kelly et al. 1936; McCauley 1945; Conant and Collins 1998; Ernst et al. 1994; Petranka 1998). A site reconnaissance was done on the initial visit and after council with MONO personnel we identified habitats for target species. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects. Intense ground searches were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1.

before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data was recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of MONO and their habitats were located by field reconnaissance are listed in Table 1. Forty-seven species had distributions that overlapped the boundaries of MONO. Please note this is a conservative list and many species are rare even within their ranges.

Species Summary

A summary of species observed during field inventories of MONO are listed in Table 2. Four species of frogs, 1 species of toad, 3 species of salamanders, 1 species of lizard, 4 species of snakes and 4 species of turtles were observed. A number of potential species was not observed, but their occurrence in the park cannot be ruled out. Several of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventorying techniques, such as drift fences combined with pitfall traps, to identify their presence.

Table 3 compares the number of potential species with the number of species found for each group. Most species unaccounted for were species where MONO was located on the edge of their geographic distribution or habitat within the park was marginal.

Habitats

MONO has several habitat types and human inhabitants created many of these. Secondary forests of the region are mostly bottomland hardwood species and the small ridges are mostly mixed deciduous forest. The understory and herbaceous layers are often dominated in many areas by exotic invasive species, especially in the floodplain of the Monocacy River. Anthropogenic disturbances created other habitats within the park such as rights-of-way, roads, trails, ponds, agricultural areas, and mowed lawns.

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park composed of agricultural fields and maintained as fields showed few species of amphibians or reptiles. Mixed deciduous forests or aquatic habitats located within the forest had the highest number of species. At least 1 pond was located within the park boundary. This pond supported amphibians, turtles, and one snake species. Flood scour depressions and other ephemeral pools located on the floodplain of the river were used as breeding areas for several frog and salamander species. Small intermittent streams draining through the park are also important habitats for several plethodontid salamander species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. A low diversity of salamander species was observed, only 3 species of woodland salamanders were found. Spotted Salamanders (*Ambystoma maculatum*) and Marbled Salamanders (*Ambystoma opacum*) should occur in MONO but were not observed. These are fossorial species that breed in early spring or in autumn, respectively. Egg masses of spotted salamanders and larvae of both species persist in ephemeral pools in the spring. Although marginal habitat was observed within the park along the floodplain of the Monocacy River, no active breeding pools for these species were observed.

The most diverse group of salamanders found in the eastern deciduous forests is the plethodontids, or lungless salamanders. This family can be roughly divided into groups based on habitat use: woodland salamanders and stream salamanders. Two woodland salamander species were observed, Red-backed Salamander (*Plethodon cinereus*) and Northern Slimy Salamander (*Plethodon glutinosus*). Small fishless 1st order-streams found within the park are ideal habitat for many species of stream-dwelling salamanders but just one species; Northern Two-lined Salamanders (*Eurycea bislineata*), was located. This species is also associated within riparian areas in MONO. Stream salamanders and their larvae are the top predators in these fishless streams. Salamanders are often referred to as environmental indicators because their moist skin is often permeable to environmental contaminants. Park managers should note their presence or absence.

Five species of salamanders whose ranges overlapped MONO were not observed. Habitat of 3 of these, Northern Dusky Salamanders (*Desmognathus fuscus*), Long-tailed Salamanders (*Eurycea longicauda*), and Northern Spring Salamanders (*Gyrinophilus porphyriticus*), was present within the park. Northern Dusky Salamanders are often abundant in non-polluted streams and relatively easy to locate when they are present. Northern Spring Salamander larvae persist in streams and are encountered in stream bottoms under rocks and can be collected by dipnet surveys. Low water quality may have reduced the numbers of this species within MONO. The ranges of two wetland species, Northern Red Salamanders (*Pseudotriton ruber*) and Four-toed Salamanders (*Hemidactylium scutatum*), are within MONO. Both wetland species can be located along the edges of wetlands where they forage or deposit eggs. Northern Red Salamanders also inhabit 1st order streams. Female Four-toed Salamanders tend their clutch of eggs for about 2 months at the edge of wetlands under vegetation or mosses. Marginal wetland habitat was observed for these 2 species but neither was found.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Northern Spring Peepers (*Pseudacris crucifer*) were the most abundant species observed, they were heard calling in wet areas around the park. Pickerel Frogs (*Rana palustris*) and Northern Green Frogs (*Rana c. melanota*) and American Bullfrogs (*Rana catesbeiana*) were found in the pond adjacent to the Visitor's Center. A true frog that was not observed but probably occurs within in the park was the Wood Frog (*Rana sylvatica*). Its egg masses or tadpoles are typically found in ephemeral pools throughout the spring.

Three other species of frogs with ranges that overlap the park that were not observed were Eastern Cricket Frogs (*Acris c. crepitans*), Upland Chorus Frogs (*Pseudacris f. feriarum*) and Eastern Gray Treefrogs (*Hyla versicolor*). No quality Eastern Cricket Frog or Upland Chorus Frog habitat was found in the park. Gray Treefrogs inhabit most wet areas during late spring and early summer.

Turtles

Figure 4 shows the distribution of turtles observed in the study. Habitat for Eastern Box Turtles (*Terrapene c. carolina*) was found throughout the park. Eastern

Snapping Turtles (*Chelydra serpentina*) and Painted Turtles (*Chrysemys picta*) were observed in the pond. Red-eared Sliders (*Trachemys s. elegans*) were observed in Monocacy River. This is a turtle that was commonly introduced by the pet trade and has become locally established in many areas, therefore it is difficult to determine natural from feral populations.

Several species of turtles were not observed but could be present. The range of Northern Red-bellied Cooters (*Pseudemys rubriventris*) is within park but no individuals were observed in the park or surrounding areas. Habitat for this turtle can be found in the Monocacy River and Visitor Center Pond. No suitable wetland habitats for Wood Turtles (*Glyptemys insculpta*) or Spotted Turtles (*Clemmys guttata*) were observed although the park is within their ranges. Wood Turtles could utilize Monocacy River and floodplain as a travel corridor. Stinkpots (*Sternotherus odoratus*) can be relatively common and locally abundant. Their habitat includes both the river and pond.

A major concern for the management of turtle species is the road kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to deposit their eggs in loose soil above the normal high water levels. Often these areas are across or along road edges close to water; park personnel should take notice of dead turtles in these areas in early to mid-summer. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations. This is important in a park such as MONO where highways bisect the park.

Lizard

Figure 5 shows the distribution of lizards observed within the park boundaries. Only 1 species of lizard (Broad-headed Skink, *Eumeces laticeps*) was found. Habitat for this species and Five-lined Skinks (*Eumeces fasciatus*) is found throughout the park, especially along outsides of buildings and edges of fields. Eastern Fence-Lizards (*Sceloporus undulatus*) were not observed, although habitat for this species is within the park. Skinks and lizards can be locally abundant within their ranges.

Snakes

The distribution of snakes observed is shown in Figure 6. Habitats for many snake species is found in limited areas throughout the park. MONO is within the range of a large number of species of snakes, but only 4 species were observed. Northern Ring-necked Snakes (*Diadophis punctatus edwardsii*) were abundant in the park and found under cover objects such as flat rocks throughout the park. Other snakes observed in the park are often associated with disturbed areas including: Black Ratsnakes (*Elaphe obsolete*), Eastern Gartersnakes (*Thamnophis s. sirtalis*) and Eastern Milksnakes (*Lampropeltis t. triangulum*).

Northern Black Racers (*Coluber constrictor*) were not observed in the park, but MONO is within their range. Black Racers are often found in transition zones of field and forest habitats, road edges, rights-of-way and other disturbed areas. The large number of roads and high traffic levels may contribute to the low number of snake species observed. Common Watersnakes (*Nerodia s. sipedon*) were not encountered, but habitat is available along the stream and pond. Eastern Wormsnake (*Carphophis amoenus*) habitat was found on floodplain forest and forest edges. MONO is within the distribution of Rough Greensnakes (*Opheodrys aestivus*). Greensnakes are often observed on vegetation close to water (Plummer 1997). Habitat for this species is found in the shrub layer throughout the park especially close to the pond and stream. This species may be in decline throughout its range. Eastern Ribbonsnakes (*Thamnophis s. sauritus*) and Queen Snakes (*Regina septemvittata*) are species associated with wetlands and waterways. Marginal habitats for both these species are found along the riparian areas in the park, but neither was observed. Habitat for Hog-nosed Snakes (*Heterodon platirhinos*) was found in the sandy floodplain of the Monocacy River and adjacent areas where toads are present.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation

of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitats for amphibians are often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water, especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or the metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding seasons to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential species in Monocacy National Battlefield

AMPHBIAIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad**
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog
Hyla versicolor – Eastern Gray Treefrog**
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog**
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma maculatum – Spotted Salamander**
Ambystoma opacum – Marbled Salamander**
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander**
Eurycea bislineata – Northern Two-lined Salamander
Eurycea l. longicauda – Long-tailed Salamander**
Gyrinophilus p. porphyriticus – Northern Spring Salamander**
Hemidactylium scutatum – Four-toed Salamander**
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon glutinosus – Northern Slimy Salamander
Pseudotriton r. ruber – Northern Red Salamander
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft**

REPTILES
Order Testudines
Family Chelydridae
Chelydra s. serpentina – Eastern Snapping Turtle
Family Emydidae
Chrysemys p. picta – Eastern Painted Turtle
Clemmys guttata – Spotted Turtle
Glyptemys insculpta – Wood Turtle
Terrapene c. carolina – Eastern Box Turtle
Trachemys scripta elegans – Red-eared Slider
Family Kinosternidae
Sternotherus odoratus -- Stinkpot

Order Squamata
Suborder Lacertilia
Family Phrynosomatidae
Sceloporus undulatus – Eastern Fence-Lizard**
Family Scincidae
Eumeces fasciatus – Common Five-lined Skink
Eumeces laticeps – Broad-headed Skink
Suborder Serpentes
Family Colubridae
Carphophis a. amoenus – Eastern Wormsnake**
Coluber c. constrictor – Northern Black Racer**
Diadophis punctatus edwardsii – Northern Ring-necked Snake
Elaphe o. obsoleta – Black Ratsnake
Heterodon platirhinos – Eastern Hog-nosed Snake
Lampropeltis t. triangulum – Eastern Milksnake
Nerodia s. sipedon – Common Watersnake**
Opheodrys a. aestivus – Northern Rough Greensnake
Opheodrys vernalis – Smooth Greensnake**
Regina septemvittata – Queen Snake**
Storeria d. dekayi – Northern Brownsnake**
Storeria o. occipitomaculata – Northern Red-bellied Snake**
Thamnophis s. sauritus – Common Ribbonsnake**
Thamnophis s. sirtalis – Eastern Gartersnake
Virginia v. valeriae – Eastern Smooth Earthsnake
Family Viperidae
Agkistrodon contortrix mokasen – Northern Copperhead**

Underline denotes species found during this study
* Literature Record
** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2 Species observed by habitat at MONO

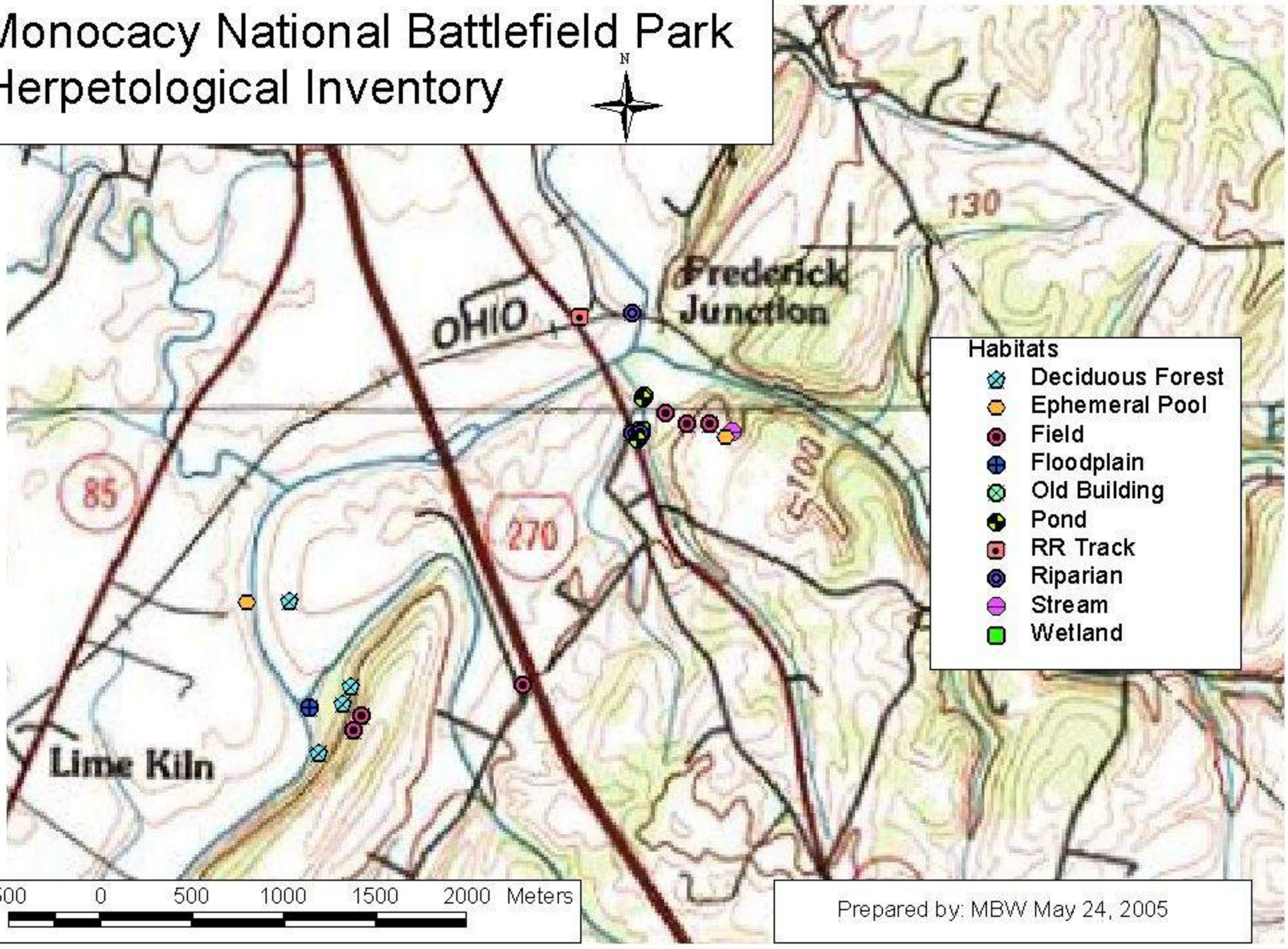
Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Field	Floodplain	Old Building	RR Track	Riparian	Pond	Stream	Wetland
Frogs and Toads												
Bufo a. americanus	9	Eastern American Toad	X	X	X							
Pseudacris c. crucifer	12	Northern Spring Peeper								X		X
Rana c. melanota	1	Northern Green Frog								X		
Rana catesbeiana	4	American Bullfrog								X		
Rana palustris	8	Pickerel Frog							X	X		
Salamanders												
Eurycea bislineata	16	Northern Two-lined Salamander						X	X		X	
Plethodon cinereus	108	Eastern Red-backed Salamander	X	X	X	X			X			
Plethodon glutinosus	4	Northern Slimy Salamander	X									

Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Field	Floodplain	Old Building	RR Track	Riparian	Pond	Stream	Wetland
Lizard												
Eumeces laticeps	4	Broad-headed Skink			**X**							
Snakes												
Diadophis p. edwardsii	41	Northern Ring-necked Snake	**X**		**X**							
Elaphe o. obsoleta	8	Black Ratsnake			**X**							
Lampropeltis t. triangulum	4	Eastern Milksnake	**X**		**X**							
Thamnophis s. sirtalis	16	Eastern Gartersnake	**X**									
Turtles												
Chelydra s. serpentina	5	Eastern Snapping Turtle								**X**		
Chrysemys p. picta	28	Eastern Painted Turtle								**X**		
Terrapene c. carolina	4	Eastern Box Turtle	**X**			**X**						
Trachemys s. elegans	4	Red-Eared Turtle						**X**				

Table 3. Summary of inventory results for MONO

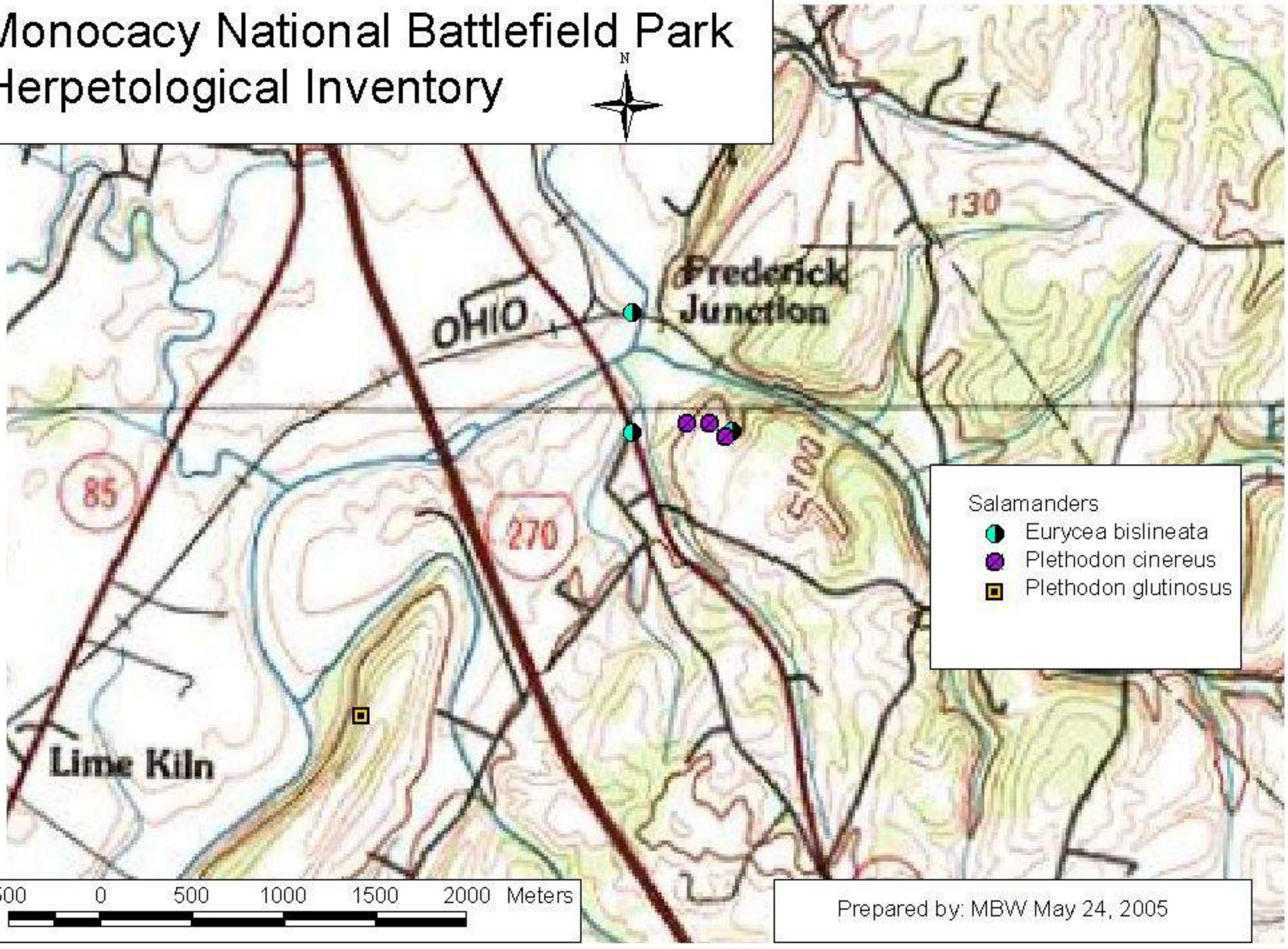
Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	11	3	27
Toads	2	1	50
Frogs	8	4	50
Turtles	7	4	57
Lizards	3	1	33
Snakes	16	4	25

Monocacy National Battlefield Park
Herpetological Inventory



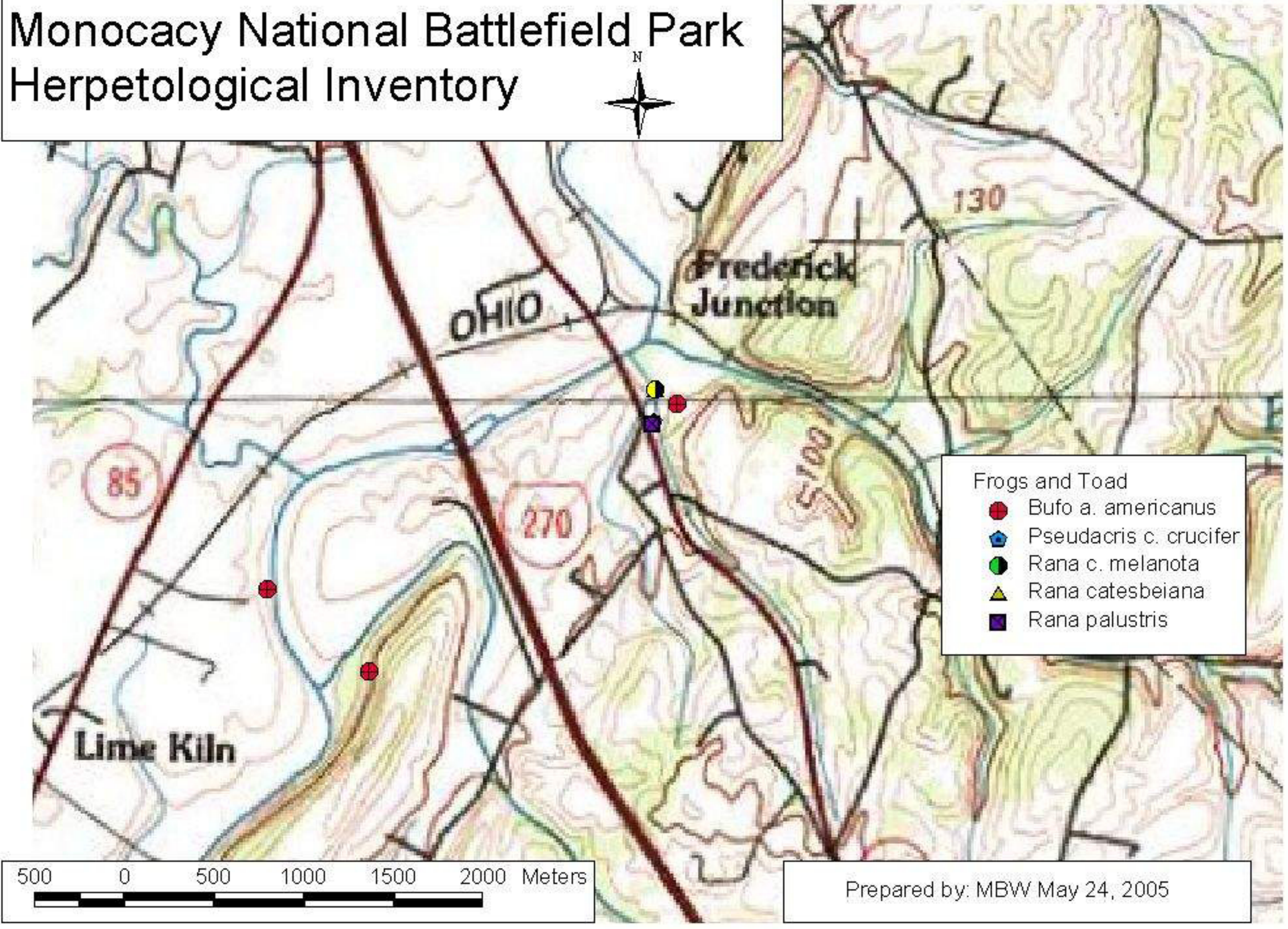
Prepared by: MBW May 24, 2005

Monocacy National Battlefield Park
Herpetological Inventory



Prepared by: MBW May 24, 2005

Monocacy National Battlefield Park
Herpetological Inventory



Prepared by: MBW May 24, 2005

Monocacy National Battlefield Park
Herpetological Inventory

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Frederick Junction

Lime Kiln

130

85

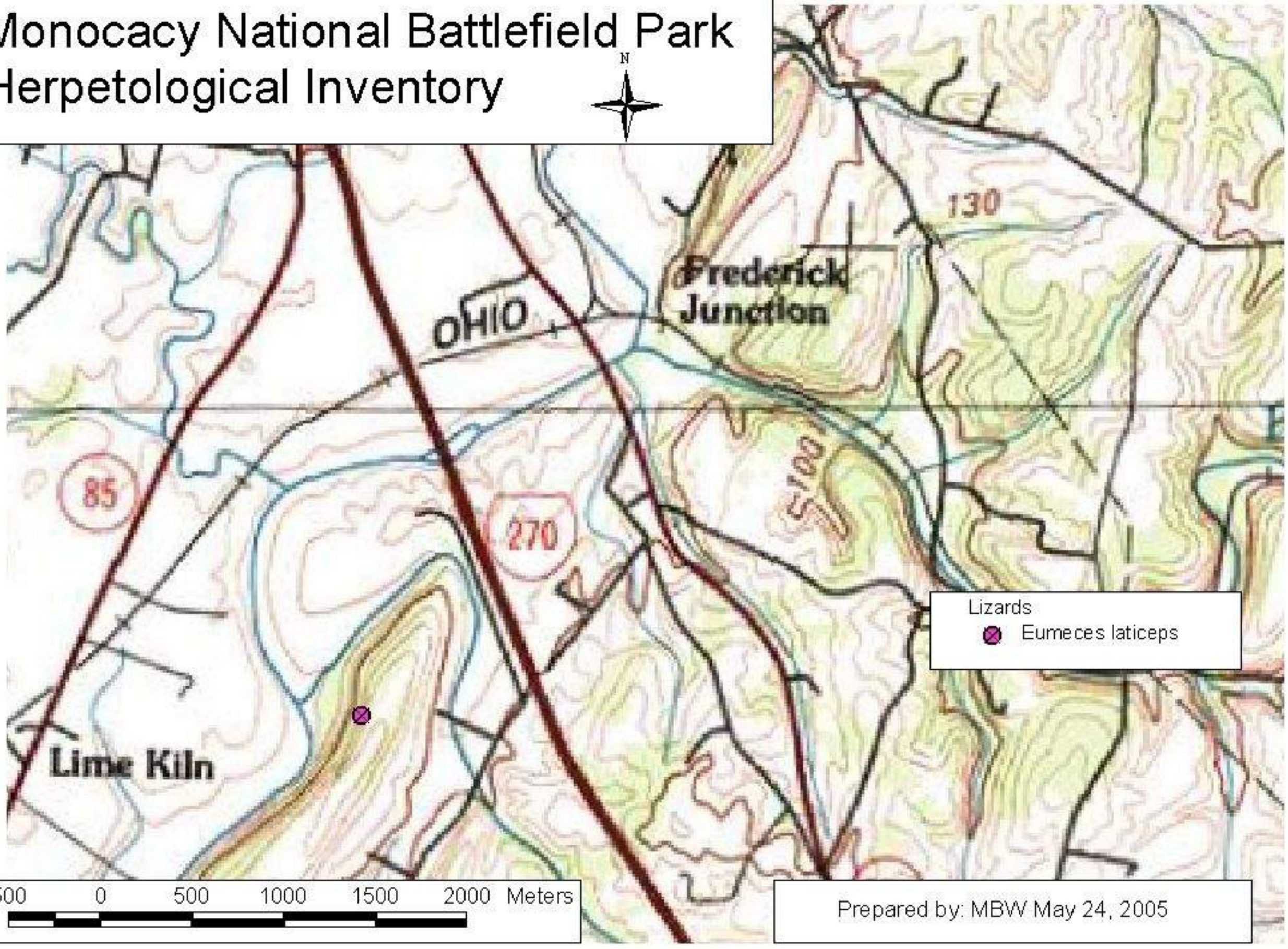
270

Turtles
- Chelydra s. serpentina
- Chrysemys p. picta
- Terrapene c. carolina
- Trachemys s. elegans

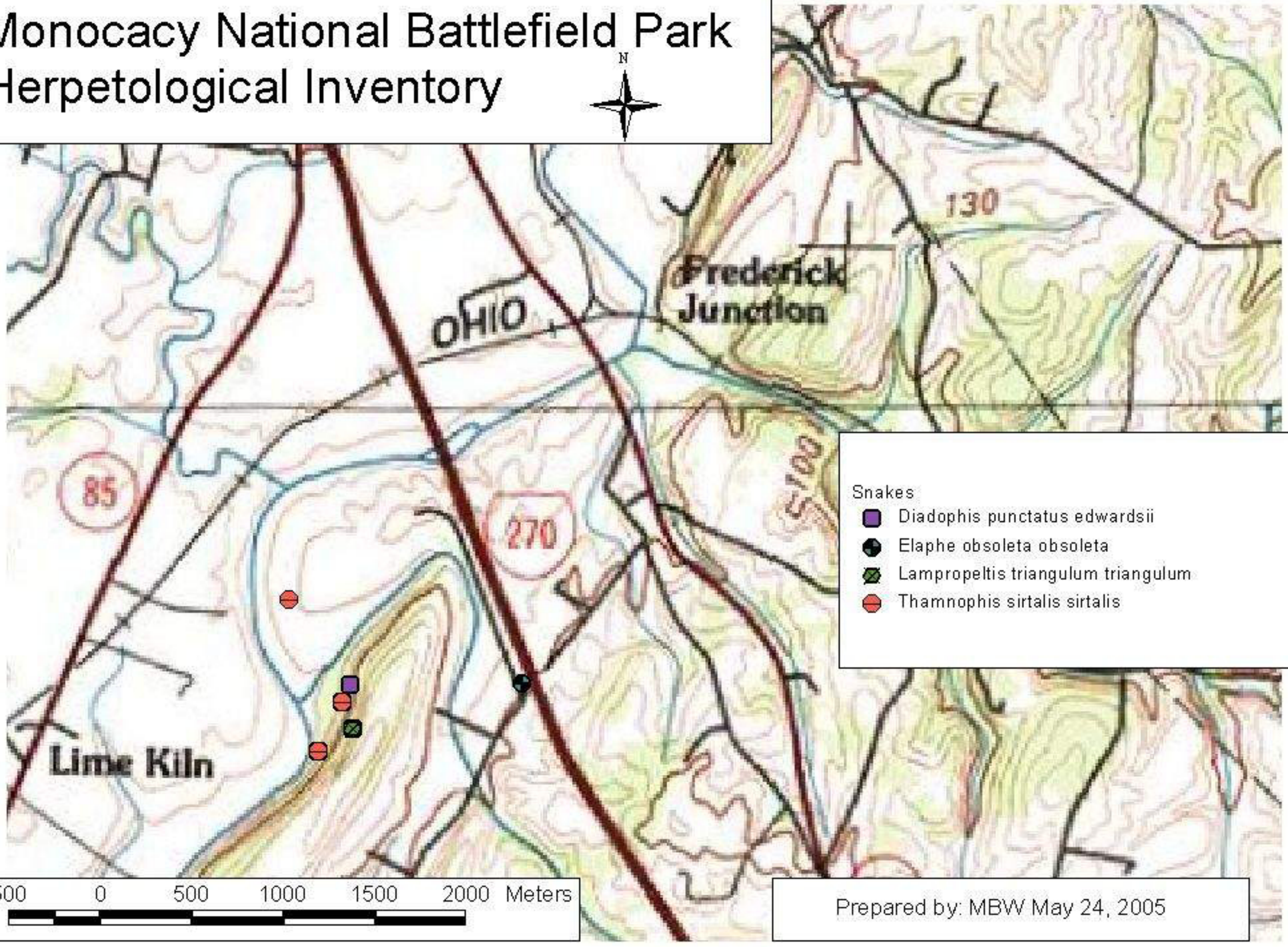
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Prepared by: MBW May 24, 2005

Monocacy National Battlefield Park
Herpetological Inventory



Monocacy National Battlefield Park
Herpetological Inventory



Prepared by: MBW May 24, 2005

APPENDIX 8

REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

ROCK CREEK PARK

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Introduction

Rock Creek Park (ROCR) is an approximately 1700-acre park in Washington, D.C. This park is situated on the lower drainage of Rock Creek just upstream with its confluence with the Potomac River. The park is a green island in the urban and suburban landscape of Washington, D.C. Drs. Robin Jung of the U.S. Geological Survey and George Middendorf and students from Howard University conducted inventories. Dr. Jung has the conducted detailed studies of amphibians at ROCR and has more extensive data than what is presented here.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of ROCR (Kelly et al. 1936; McCauley 1945; Linzey and Gifford 1981; Tobey 1985; Conant and Collins 1998; Ernst et al. 1994; Mitchell 1994; Mitchell and Reay 1999; Petranka 1998). Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data was recorded onto

standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of ROCR and whose habitats were located by field reconnaissance are listed in Table 1. Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Forty-five species had distributions that overlapped the boundaries of ROCR. Please note this is a very conservative list and many species are rare even within their ranges.

Species Summary

A summary of species observed during field inventories of ROCR are listed in Table 2. Habitat destruction within and adjacent to the park limits the available space and habitat to support wildlife. Four species of frogs, 1 species of toad, 6 species of salamanders, 0 species of lizards, 2 species of snakes and 1 species of turtle were observed. A number of potential species were not observed, but their occurrence in the park cannot be ruled out. Several of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventorying techniques, such as drift fences combined with pitfall traps, to identify their presence.

Table 3 compares the number of potential species with the number of species found for each group. Most species unaccounted for were species where ROCR was located on the edge of their geographic distribution or habitat within the park was marginal.

Habitats

ROCR has several habitat types, many created by human inhabitants. Secondary forests of the region are generally bottomland hardwood species and the small ridges are mostly mixed deciduous forest. The understory and herbaceous layers are often dominated in many areas by exotic invasive species, especially in the floodplain of Rock Creek. Efforts to remove invasive plant species have been undertaken by the park.

Anthropogenic disturbances created other habitats within the park such as rights-of-way, roads, trails, sports areas, and mowed lawns.

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park that were covered with sport complexes or maintained as fields showed few species of amphibians or reptiles. Mixed deciduous forests or aquatic habitats located within the forest showed the highest number of species. Flood scour depressions and other ephemeral pools located on the floodplain of the creek were used as breeding areas for several frog and salamander species. Small intermittent streams draining through the park are also important habitats for several plethodontid salamander species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. A low diversity of salamander species was observed including only 4 species of Plethodontidae (Woodland Salamanders). Two species of *Ambystoma* were observed, Spotted Salamanders (*Ambystoma maculatum*) and Marbled Salamanders (*Ambystoma opacum*). These species are fossorial species that breed in the early spring or in the fall, respectively. Egg masses or larvae of both species persist in ephemeral pools in the spring. Habitat was observed within the park along the floodplain of the Rock Creek.

The most diverse group of salamanders found in the eastern deciduous forests is the plethodontids, or lungless salamanders. This family can be roughly divided into groups based on habitat use: woodland salamanders and stream salamanders. Only one woodland salamander species was observed, Red-backed Salamander (*Plethodon cinereus*). Three species of stream salamanders were found in small fishless streams, which are ideal habitat for several species of salamanders. Stream salamanders and their larvae are the top predators in these fishless streams. Northern Two-lined Salamanders (*Eurycea bislineata*) and Northern Spring Salamanders (*Gyrinophilus porphyriticus*) were found in 1st order streams or the associated riparian area. Most shaded clean streams in the park and surrounding area should support these salamanders. Salamanders are often referred to as environmental indicators because their moist skin is often permeable to environmental contaminants.

Four species of salamanders whose ranges overlapped ROCR their habitat is present were not observed. Two of these are stream salamanders, including Northern Dusky Salamanders (*Desmognathus fuscus*) and Long-tailed Salamanders (*Eurycea longicauda*). Northern Dusky Salamanders are often abundant in 1st-order streams and are one of the easier species to locate when they are present. Long-tailed Salamanders are also found in and around 1st order streams as well as seepage areas. They are generally less common than Northern Dusky Salamanders. The ranges of two wetland salamander species are within ROCR. Northern Red Salamanders (*Pseudotriton ruber*) and Four-toed Salamanders (*Hemidactylium scutatum*) were not found but could be present. Both wetland species can be located along the edges of wetlands where they forage or deposit eggs. Northern Red Salamanders also occur in and around 1st order streams. Female Four-toed Salamanders tend their clutch of eggs for about 2 months and can often be located at the edge of wetlands under vegetation or mosses. Marginal wetland habitat was observed for these two species.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Northern Spring Peepers (*Pseudacris crucifer*) were the most abundant species observed and they were heard calling in wet areas around the park. Wood Frogs (*Rana sylvatica*) and Northern Green Frogs (*Rana c. melanota*) and American Bullfrogs (*Rana catesbeiana*) were found in the pond adjacent to the Visitor's Center.

Four species whose ranges overlap the park that were not observed were Eastern Cricket Frogs (*Acris c. crepitans*), Upland Chorus Frog (*Pseudacris f. feriarum*), Cope's Gray Treefrog (*Hyla chrysoscelis*), and Eastern Spadefoots (*Scaphiopus holbrookii*). No quality Eastern Cricket Frog or Upland Chorus Frog habitat was found in the park. Gray Treefrogs are found in most wet places including roadside ditches and road ruts pools. Spadefoots (*Scaphiopus holbrookii*) are fossorial and only emerges when environmental conditions are suitable. Without searching during ideal weather conditions, i.e., during heavy rains, it is unlikely that the Spadefoots would be found during this study even if they were present within the park boundaries. Sandy areas adjacent to the floodplain of

the river and low areas of the park that collect standing water for several days after late spring and summer heavy rain and flood events are potential breeding areas for this toad.

Turtles

Figure 4 shows the distribution of turtles observed in the study. Only one species of turtle was observed, Eastern Box Turtles (*Terrapene c. carolina*), and habitat for this species was found throughout the park. The ranges of several other turtles Eastern Snapping Turtles (*Chelydra serpentina*) and Painted Turtles (*Chrysemys picta*), Red-eared Sliders (*Trachemys s. elegans*), Northern Red-bellied Cooters (*Pseudemys rubriventris*) are within park but no individuals were observed. No suitable wetland habitat for Spotted Turtles (*Clemmys guttata*) was observed within the park, although the park is within the range. Stinkpots (*Sternotherus odoratus*) and Eastern Mud Turtles (*Kinosternon subrubrum*) were also not observed. Stinkpots are relatively common and can be locally abundant and probably occur in Rock Creek. Eastern Mud Turtles prefer slow-moving streams with muck bottoms and abundant vegetation (Ernst et al. 1994).

A major concern for the management of turtle species is the road-kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to bury their eggs in loose soil above the normal high water levels. Often these areas are across or along road edges close to water; park personnel should take notice of dead turtles in these areas in early to mid summer. Eastern Box turtles move around in their home ranges, which often lead them across roads where they are killed. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations. This is important in a park such as ROCR where the park is surrounded by high traffic and has very large visitation.

Lizard

No lizards or skinks were observed at ROCR, although habitat for lizards and skinks is found throughout the park, especially along outsides of buildings and edges of fields. Skinks and lizards are locally abundant within their ranges and they become inactive when environmental conditions are not optimum. Many skinks, especially Common Five-lined Skinks (*Eumeces fasciatus*) are tolerant of humans and are often found in or around dwellings.

Snakes

The distribution of snakes observed is shown in Figure 5. Habitats for many species of snakes are found in limited amounts throughout the park. The relatively small size of ROCR and the large number of visitors (many of which probably do not like snakes) may contribute to the low number of snake species observed. Like turtles, snakes are often long-lived and produce limited number of offspring; therefore attrition by humans can lead to reduced numbers or local extirpation. ROCR is within the range of a large number of snakes, but only 2 species of snakes were observed. No snakes were abundant in the park. One Black Ratsnake (*Elaphe obsolete*) and 1 Eastern Wormsnake (*Carphophis amoenus*) were found. Other snakes that are often found in disturbed areas include, Northern Ring-necked Snakes (*Diadophis p. edwardsii*), Eastern Gartersnakes (*Thamnophis sirtalis*), Eastern Milksnakes (*Lampropeltis triangulum*) and Northern Black Racers (*Coluber c. constrictor*). These species are often found in transition zones of field and forest habitats, road edges, rights-of-way, and other disturbed areas. The large number of roads and high traffic may contribute to the low number of snake species observed. Common Watersnakes (*Nerodia s. sipedon*) and Queen Snakes (*Regina septemvittata*) were not encountered, but habitat was available along the stream. ROCR is within the distribution of Rough Greensnakes (*Opheodrys aestivus*), this species is often observed on vegetation close to water (Plummer 1997). Habitat for this species is found in the shrub layer throughout the park especially close to the Rock Creek. This species may be in decline throughout its range. Eastern Ribbonsnakes (*Thamnophis s. sauritus*) and Queen Snakes (*Regina septemvittata*) are species associated with wetlands and waterways. Marginal habitats for both these species are found along the riparian areas in the park, but neither was observed. Habitat for Hog-nosed Snake (*Heterodon platirhinos*) was found in the sandy floodplain of the Rock Creek and adjacent areas where toads are present.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation

of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitats for amphibians are often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water, especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or the metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing the parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995) and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential species in Rock Creek Park

AMPHIBIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog
Hyla chrysoscelis – Cope's Gray Treefrog
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog*
Family Pelobatidae
Scaphiopus holbrookii – Eastern Spadefoot*
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog*
Rana sphenocephala utricularia – Southern Leopard Frog
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma maculatum – Spotted Salamander
Ambystoma opacum – Marbled Salamander
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander
Eurycea bislineata – Northern Two-lined Salamander
Eurycea l. longicauda – Long-tailed Salamander*
Gyrinophilus p. porphyriticus – Northern Spring Salamander
Hemidactylium scutatum – Four-toed Salamander*
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon glutinosus – Northern Slimy Salamander**
Pseudotriton m. montanus – Eastern Mud Salamander
Pseudotriton r. ruber – Northern Red Salamander*
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft

REPTILES
Order Testudines
Family Chelydridae
Chelydra s. serpentina – Eastern Snapping Turtle*
Family Emydidae
Chrysemys p. picta – Eastern Painted Turtle*
Clemmys guttata – Spotted Turtle
Glyptemys insculpta – Wood Turtle

Malaclemys terrapin – Northern Diamond-backed Terrapin**
Pseudemys rubriventris – Northern Red-bellied Cooter**
Terrapene c. carolina – Eastern Box Turtle
Trachemys scripta elegans – Red-eared Slider

Family Kinosternidae

Kinosternon subrubrum – Eastern Mud Turtle
Sternotherus odoratus -- Stinkpot

Order Squamata

Suborder Lacertilia

Family Phrynosomatidae

Sceloporus undulatus – Eastern Fence-Lizard*

Family Scincidae

Eumeces fasciatus – Common Five-lined Skink
Eumeces laticeps – Broad-headed Skink
Scincella lateralis – Little Brown Skink*

Suborder Serpentes

Family Colubridae

Carphophis a. amoenus – Eastern Wormsnake
Coluber c. constrictor – Northern Black Racer*
Diadophis punctatus edwardsii – Northern Ring-necked Snake*
Elaphe o. obsoleta – Black Ratsnake
Heterodon platirhinos – Eastern Hog-nosed Snake**
Lampropeltis calligaster rhombomaculata – Mole Kingsnake
Lampropeltis g. getula – Eastern Kingsnake**
Lampropeltis t. triangulum – Eastern Milksnake*
Nerodia s. sipedon – Common Watersnake*
Opheodrys a. aestivus – Northern Rough Greensnake**
Regina septemvittata – Queen Snake*
Storeria d. dekayi – Northern Brownsnake*
Storeria o. occipitomaculata – Northern Red-bellied Snake
Thamnophis s. sauritus – Common Ribbonsnake
Thamnophis s. sirtalis – Eastern Gartersnake*
Virginia v. valeriae – Eastern Smooth Earthsnake*

Family Viperidae

Agkistrodon contortrix mokasen – Northern Copperhead

Underline denotes species found during this study
* Literature Record
** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2 Species observed at ROCR

Scientific Name	Number	Common Name	Ephemeral Pool	Stream
Frogs and Toads				
Bufo a. americanus	23	Eastern American Toad	**X**	
Pseudacris c. crucifer	2	Northern Spring Peeper	**X**	
Rana c. melanota	2	Northern Green Frog	**X**	
Rana catesbeiana	3	American Bullfrog	**X**	
Rana sylvatica	15	Wood Frog	**X**	
Salamanders				
Ambystoma maculatum	34	Spotted Salamander	**X**	
Ambystoma opacum	1	Marbled Salamander	**X**	
Desmognathus fuscus	29	Northern Dusky Salamander		**X**
Eurycea bislineata	37	Northern Two-lined Salamander	**X**	**X**
Gyrinophilus p. porphyriticus	1	Northern Spring Salamander		**X**
Plethodon cinereus	13	Eastern Red-backed Salamander	**X**	**X**
Snakes				
Carphophis a. amoenus	1	Eastern Wormsnake		**X**
Elaphe o. obsoleta	1	Black Ratsnake	**X**	
Turtle				
Terrapene c. carolina	1	Eastern Box Turtle	**X**	

Table 3. Summary of inventory results for ROCR

Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	12	6	50
Toads	3	1	33
Frogs	9	4	45
Turtles	10	1	10
Lizards	4	0	0
Snakes	17	2	12

Rock Creek Park Herpetological Inventory

N

Habitats
- Ephemeral Pool
- Stream
- Park Boundary

500 0 500 1000 1500 2000 Meters

Prepared by: MBW June 2005

Rock Creek Park Herpetological Inventory

N

Salamanders
- Ambystoma maculatum
- Ambystoma opacum
- Desmognathus fuscus
- Eurycea bislineata
- Gyrinophilus p. porphyriticus
- Plethodon cinereus
- Park Boundary

500 0 500 1000 1500 2000 Meters

Prepared by: MBW June 2005

Rock Creek Park Herpetological Inventory

N

Frogs and Toads
- Bufo a. americanus
- Pseudacris c. crucifer
- Rana c. melanota
- Rana catesbeiana
- Rana sylvatica

Park Boundary

500 0 500 1000 1500 2000 Meters

Prepared by: MBW June 2005

Rock Creek Park Herpetological Inventory

N

Turtles

- Terrapene c. carolina
- Park Boundary

500 0 500 1000 1500 2000 Meters

Prepared by: MBW June 2005

Rock Creek Park Herpetological Inventory

N

Snakes
- Carphophis a. amoenus
- Elaphe o. obsoleta
- Park Boundary

500 0 500 1000 1500 2000 Meters

Prepared by: MBW June 2005

APPENDIX 9

FINAL REPORT

REPTILE AND AMPHIBIAN INVENTORIES IN THE NATIONAL CAPITAL REGION

WOLF TRAP NATIONAL PARK FOR THE PERFORMING ARTS

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Figure 3. Distribution of frog and toad species

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Figure 5. Distribution of lizard species

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Introduction

Wolf Trap National Park for the Performing Arts (WOTR) is approximately 130 acres with over half managed as natural areas. The park is located in the rolling hills of the Virginia Piedmont on the outskirts of Washington, D.C. Drs. Thomas K. Pauley and Mark B. Watson conducted inventories.

Materials and Methods

A detailed description of the methods is presented in Appendix 1 (Inventory Methods Handbook). This handbook was compiled from the research experiences of Drs. Pauley, Watson and Mitchell and published protocols. The handbook was used to teach students and other personnel associated with the study. An overview of the methods is presented here.

In general we used a habitat based searching approach. Prior to beginning inventories a list of potential species was generated to allow us to target particular habitat types used by these species. Potential species were recorded if published distribution maps or accounts overlapped the location of WOTR (Kelly et al. 1936; McCauley 1945; Linzey and Gifford 1981; Tobey 1985; Conant and Collins 1998; Ernst et al. 1994; Mitchell 1994; Petranka 1998). Species with specialized habitat requirements were removed from the potential species list if adequate habitat was not found within the park. Intense ground searches (Visual Encounter Survey [VES]) were then conducted in suitable habitats in multiple locations. These searches included scanning the ground surface and looking in and under potential cover objects.

Spatial data were collected using hand-held global positioning system (GPS) units. Data were recorded as NAD 83 UTM coordinates. UTM Coordinates were converted to digital degrees using the computer program CORPSCON version 6.0.1. before plotting to overlay the park boundary shape file. Digital images of each species captured were taken before the specimen was released. Data was recorded onto standardized data collection sheets. Captured animals were identified, measured and released at the site of capture. No animals were killed or harmed during this study.

Results and Discussion

Potential Species

Potential species found within the boundaries of WOTR and their habitats located by field reconnaissance are listed in Table 1. Forty-nine species had distributions that overlapped the boundaries of WOTR. The list of potential species is a conservative list used to guide investigation in this study and future studies.

Species Summary

A summary of species observed during field inventories of WOTR are listed in Table 2. Few amphibians and reptiles were observed and this is probably because of habitat destruction within and adjacent to the park. Five species of frogs, 1 species of toad, 4 species of salamanders, 1 species of lizard, 2 species of snakes, and 3 species of turtles were observed. A number of potential species were not observed, but their occurrence in the park cannot be ruled out. Several of these species are rare even in optimum habitats and others are secretive or fossorial and may take several years using specialized inventory techniques, such as drift fences combined with pitfall traps, to determine their status.

Table 3 compares the number of potential species with the number of species found for each group. Most species unaccounted for were species where WOTR was located on the edge of their geographic distribution or habitat within the park was marginal.

Habitats

WOTR has several habitat types, some created by human inhabitants. Forests of the region consist mostly of bottomland hardwood species and mixed deciduous species on small ridges. The understory and herbaceous layers were dominated in many areas by exotic invasive species, especially in the floodplain of the Wolf Trap Creek. Anthropogenic disturbances created other habitats within the park such as rights-of way, roads, trails, ponds, and mowed lawns.

Figure 1 shows the distribution of habitats where animals were observed. Areas of the park covered with agricultural fields or maintained as fields yielded no species of amphibians or reptiles. Highest number of species was found in mixed deciduous forests

and aquatic habitats located within the forest. At least 1 pond was located within the park boundary. This pond supported amphibians, turtles, and one snake species. Flood scour depressions and other ephemeral pools located on the floodplain of the creek were used as breeding areas for several frog and salamander species. Small intermittent streams draining the park are also important habitats for several plethodontid salamander species. These shady moist habitats were inhabited by salamanders and during the dry summer, small still pools were refugia for several frog species.

Salamanders

The distribution of salamander species observed in the park is shown in Figure 2. A diversity of salamander species from 3 taxonomic families (Salamandridae, Ambystomatidae, and Plethodontidae) was found. The 1 salamandrid, Red-spotted Newt (*Notophthalmus viridescens*), and the 1 ambystomatid, Spotted Salamander (*Ambystoma maculatum*) were observed in the pond. One species of *Ambystoma* not observed that may be present is the Marbled Salamander (*Ambystoma opacum*). This is a fossorial species that breeds in the fall. Its larvae persist through the winter and spring and are often found in the same pools as other ambystomatid species. Although suitable habitat was observed within the park, extensive dipnet surveys produced no Marbled Salamander larvae. Park managers should note their presence or absence.

The most diverse group of salamanders found in the eastern deciduous forests is the plethodontids, or lungless salamanders. This family can be roughly divided into groups based on habitat use: woodland salamanders and stream salamanders. One woodland salamander was observed, Red-backed Salamander (*Plethodon cinereus*). One species of stream salamander, Northern Two-lined Salamanders (*Eurycea bislineata*), was found. Small fishless 1st order streams are ideal habitat for many species of salamanders. Most shaded clean streams in the park and the riparian area should support these salamanders. Salamanders are often referred to as environmental indicators because their moist skin is often permeable to environmental contaminants. Stream salamanders and their larvae are the top predators in these fishless streams.

Four species of aquatic to semi-aquatic salamanders with ranges that overlapped WOTR were not observed. Two of these, Northern Dusky Salamanders (*Desmognathus*

fuscus) and Three-lined Salamanders (*Eurycea guttolineata),* are stream-dwelling species. Northern Dusky Salamanders are often abundant in non-polluted streams and are one of the easier species to locate when they are present. Three-lined Salamander larvae persist in streams for several months and can be encountered in stream bottoms under rocks and may be collected by dipnet surveys. Low water quality may have reduced the numbers of this species within WOTR. The ranges of two wetland salamander species, Northern Red Salamanders (*Pseudotriton ruber*) and Four-toed Salamanders (*Hemidactylium scutatum*) overlap WOTR but neither species was located. Both wetland species can be located along the edges of wetlands where they forage or deposit eggs. Northern Red Salamanders are also found in and around small streams. Female Four-toed Salamanders tend their eggs for about 2 months and can often be located at the edge of wetlands under vegetation or mosses. Habitat for this species is found in small wetland areas of the park, especially those with shade and moss at the water's edge.

Frogs and Toads

Figure 3 shows the distribution of frog and toad species observed in the park. Northern Spring Peepers (*Pseudacris c. crucifer*), were the most abundant species observed, they were heard calling in wet areas throughout the park.
Gray Treefrogs (*Hyla versicolor*) were observed calling in floodplains throughout the park. Wood Frogs (*Rana sylvatica*) and their egg masses were in found in ephemeral pools along the floodplain. Pickerel Frogs (*Rana palustris*) and Northern Green Frogs (*Rana c. melanota*) were found in wet areas and pools along the floodplain. Habitat for American Bullfrog (*Rana catesbeiana*) was found in the pond, but no individuals were captured. The pond is also a breeding area for Pickerel Frogs and Northern Green Frogs.

Ranges of 2 other species, Eastern Cricket Frogs (*Acris c. crepitans*) and Upland Chorus Frogs (*Pseudacris f. feriarum*), overlap the location of the park but we did not find optimal habitats of either.

Turtles

Figure 4 shows the distribution of turtles observed in the study. Habitat for Eastern Box Turtles (*Terrapene c. carolina*) was found throughout the park. Northern

Red-bellied Cooters (*Pseudemys rubriventris*) and Painted Turtles (*Chrysemys picta*) were observed in the pond.

The range of Red-eared Sliders (*Trachemys s. elegans*) is within park but none was observed in the park or surrounding areas. This is a turtle that was commonly introduced by the pet trade and has become locally established in many areas. No wetland habitat for Spotted Turtles (*Clemmys guttata*) was observed within the park although the park is within its ranges. Eastern Snapping turtles (*Chelydra serpentina*) and Stinkpots (*Sternotherus odoratus*) were not observed. They are relatively common and could occur in both the creek and pond.

A major concern for the management of turtle species is the road kill mortality for nesting females on the busy highways of the park and surrounding area. Female turtles tend to leave waterways and travel upslope to bury their eggs in loose soil above normal high water levels. Often these areas are across or along road edges close to water. Park personnel should take notice of dead turtles in these areas in early to mid-summer. Turtles are long-lived with relatively low fecundity and attrition could lead to declines in populations. This is especially important in a park such as WOTR where large numbers of visitors and traffic are confined to small areas.

Lizards

Figure 5 shows the distribution of lizards observed within the park boundaries. Only 1 species of lizard (Five-lined Skink, *Eumeces fasciatus*) was found. Habitat for this species and other skinks is found throughout the park, especially along outsides of buildings and edges of fields. The Eastern Fence-Lizard (*Sceloporus undulatus*) was not observed, although habitat for this species is within the park.

Snakes

The distribution of snakes observed within WOTR is shown in Figure 6. While habitats for many species of snakes are found in limited areas throughout the park, only 2 species were observed. Common Watersnakes (*Nerodia sipedon*) were encountered along the stream and habitat for this species is found in and around the pond and small streams. An Eastern Wormsnake (*Carphophis amoenus*) was found on floodplain forest.

The small size of the park and a large portion of the park that is maintained as lawn or parking reduces the chances of encountering many snakes. Roads create barriers for movements of snakes as well as other species of reptiles and species of amphibians. Black Ratsnakes (*Elaphe obsolete*) and Northern Black Racers (*Coluber c. constrictor*) frequently fall victim to vehicular traffic while crossing or basking on roads. Black Ratsnakes and Northern Black Racers were not observed in the park, but WOTR is within their ranges. These species are often found in transition zones of field and forest habitats, road edges, rights-of-way and other disturbed areas. WOTR is within the distribution of Rough Greensnakes (*Opheodrys aestivus*) but none was found. Rough Greensnakes are often observed on vegetation close to water (Plummer 1997). Habitat for this species is found in the shrub layer throughout the park especially close to the pond and stream. This species may be in decline throughout its range. Eastern Ribbonsnakes (*Thamnophis s. sauritus*) and Queen Snakes (*Regina septemvittata*) are species associated with wetlands and waterways. Habitats for both species are found along the stream in the park, but neither was observed. No species of snake was found in abundance in the park.

Conclusion and Recommendations

National Parks in the Nation's Capital Region have the unique opportunity to preserve historical areas and artifacts as well as natural areas. The rapid increase in urban sprawl and habitat loss in the area surrounding the nation's capitol make the conservation of these natural areas very important (Murphy 1988). The preservation of historic area and natural habitats should be considered in concert.

Breeding habitats for amphibians are often created and lost by human activities. Many species breed in ephemeral ponds and ditches of standing water. Standing water, especially those areas repeatedly utilized by amphibians should be maintained and in areas where little standing water is available, new habitat can be created to replace that lost due to construction. Simple steps such as postponing roadside ditch maintenance until after the breeding season or the metaphoric period of young frogs and toads are examples of conservation practices that benefit amphibian populations. Amphibians often migrate *en mass* during breeding season to breeding areas. Large numbers of

amphibians can be killed on roads and highways at this time, limiting traffic in known amphibian crossing areas at night during spring rains can easily reduce this mortality.

Other problems facing parks are protecting watersheds from run-off from impervious surfaces, habitat fragmentation, increase in invasive plants (Pyle 1995), and subsidized predator species. Habitat fragmentation by existing and new road construction and trails leads to direct mortality by vehicular and pedestrian traffic as well as creating barriers for migration and gene flow in a population. Opening forest canopies dries the forest floor and increases insolation, which leads to increased soil temperatures that reduce numbers of salamander species. Many small amphibian species cannot or will not cross roads; therefore these barriers create islands of genetically isolated populations (Gibbs 1998). Practices should be implemented to help maintain forest litter and amphibian breeding areas (Mitchell et al 1997; Madison 1997).

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Table 1. Potential species in Wolf Trap Farm Park for the Performing Arts

AMPHIBIANS
Order Anura
Family Bufonidae
Bufo a. americanus – Eastern American Toad
Bufo fowleri – Fowler's Toad**
Family Hylidae
Acris c. crepitans – Eastern Cricket Frog**
Hyla chrysoscelis – Cope's Gray Treefrog
Pseudacris c. crucifer – Northern Spring Peeper
Pseudacris f. feriarum – Upland Chorus Frog
Family Ranidae
Rana catesbeiana – American Bullfrog
Rana clamitans melanota – Northern Green Frog
Rana palustris – Pickerel Frog
Rana sphenocephala utricularia –Southern Leopard Frog**
Rana sylvatica – Wood Frog
Order Caudata
Family Ambystomatidae
Ambystoma maculatum – Spotted Salamander
Ambystoma opacum – Marbled Salamander
Family Plethodontidae
Desmognathus fuscus – Northern Dusky Salamander**
Eurycea bislineata – Northern Two-lined Salamander
Eurycea guttolineata – Three-lined Salamander**
Hemidactylium scutatum – Four-toed Salamander
Plethodon cinereus – Eastern Red-backed Salamander
Plethodon cylindraceus – White-spotted Slimy Salamander**
Pseudotriton r. ruber – Northern Red Salamander
Family Salamandridae
Notophthalmus v. viridescens – Red-spotted Newt, Red Eft

REPTILES
Order Testudines
Family Chelydridae
Chelydra s. serpentina – Eastern Snapping Turtle**
Family Emydidae
Chrysemys p. picta – Eastern Painted Turtle
Clemmys guttata – Spotted Turtle
Pseudemys rubriventris – Northern Red-bellied Cooter
Terrapene c. carolina – Eastern Box Turtle
Trachemys scripta elegans – Red-eared Slider
Family Kinosternidae
Sternotherus odoratus -- Stinkpot

Order Squamata
Suborder Lacertilia
Family Phrynosomatidae
Sceloporus undulatus – Eastern Fence-Lizard**
Family Scincidae
Eumeces fasciatus – Common Five-lined Skink
Eumeces laticeps – Broad-headed Skink
Scincella lateralis – Little Brown Skink
Suborder Serpentes
Family Colubridae
Carphophis a. amoenus – Eastern Wormsnake
Coluber c. constrictor – Northern Black Racer**
Diadophis punctatus edwardsii – Northern Ring-necked Snake**
Elaphe o. obsoleta – Black Ratsnake**
Heterodon platirhinos – Eastern Hog-nosed Snake
Lampropeltis calligaster rhombomaculata – Mole Kingsnake
Lampropeltis g. getula – Eastern Kingsnake**
Lampropeltis t. triangulum – Eastern Milksnake
Nerodia s. sipedon – Common Watersnake
Opheodrys a. aestivus – Northern Rough Greensnake**
Regina septemvittata – Queen Snake
Storeria d. dekayi – Northern Brownsnake
Storeria o. occipitomaculata – Northern Red-bellied Snake**
Thamnophis s. sauritus – Common Ribbonsnake
Thamnophis s. sirtalis – Eastern Gartersnake
Virginia v. valeriae – Eastern Smooth Earthsnake
Family Viperidae
Agkistrodon contortrix mokasen – Northern Copperhead**

Underline denotes species found during this study
* Literature Record
** NPSpecies refers to species on the NPSpecies database but have no verifiable documentation (Mitchell 2000)

Table 2. Species observed by habitat at WOTR

Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Floodplain	Old Field	Parking Lot	Pond	Riparian	Stream	Wetland
Frogs and Toads											
Bufo a. americanus	460	Eastern American Toad	X	X				X			
Hyla chrysoscelis	8	Cope's Grey Treefrog	X				X	X			
Pseudacris c. crucifer	8	Northern Spring Peeper		X			X	X	X		
Rana c. melanota	24	Northern Green Frog		X					X	X	X
Rana palustris	4	Pickerel Frog							X		
Rana sylvatica	2	Wood Frog		X							
Salamanders											
Ambystoma maculatum	2	Spotted Salamander		X							
Eurycea bislineata	12	Northern Two-lined Salamander							X	X	
Notophthalmus v. viridescens	4	Red-spotted Newt						X			

Scientific Name	Number	Common Name	Deciduous Forest	Ephemeral Pool	Floodplain	Old Field	Parking Lot	Pond	Riparian	Stream	Wetland
Plethodon cinereus	1	Eastern Red-backed Salamander		**X**							
Lizard											
Eumeces fasciatus	4	Common Five-lined Skink	**X**								
Snakes											
Carphophis a. amoenus	8	Eastern Wormsnake	**X**								
Nerodia s. sipedon	8	Common Watersnake							**X**	**X**	
Turtles											
Chrysemys p. picta	1	Eastern Painted Turtle						**X**			
Pseudemys rubriventris	8	Northern Red-bellied Cooter						**X**			
Terrapene c. carolina	16	Eastern Box Turtle			**X**	**X**			**X**		

Table 3. Summary of Inventory Results For WOTR

Taxonomic Group	Potential Number of Species	Number of Species Found	Percentage
Salamanders	10	4	40
Toads	2	1	50
Frogs	9	5	56
Turtles	7	3	43
Lizards	4	1	25
Snakes	17	2	12

Wolf Trap Farm Park
Herpetological Inventories

N

Habitats
- Deciduous Forest
- Ephemeral Pool
- Ephemal Pool
- Floodplain
- Old Field
- Parking Lot
- Pond
- Riparian
- Stream
- Wetland
- Streams
- Pond
- Park Boundary

90 0 90 180 Meters

MBW 5/20/05

Wolf Trap Farm Park
Herpetological Inventories

N

Salamanders
- Ambystoma maculatum
- Eurycea bislineata
- Notophthalmus v. viridescens
- Plethodon cinereus

Streams
Pond
Park Boundary

90 0 90 180 Meters

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Wolf Trap Farm Park
Herpetological Inventories

N

Frogs and Toads
- Bufo a. americanus
- Hyla chrysoscelis
- Pseudacris c. crucifer
- Rana c. melanota
- Rana palustris
- Rana sylvatica

Streams

Pond

Park Boundary

90 0 90 180 Meters

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Wolf Trap Farm Park
Herpetological Inventories

N

Turtles
- Chrysemys p. picta
- Pseudemys rubriventris
- Terrapene c. carolina

Streams

Pond

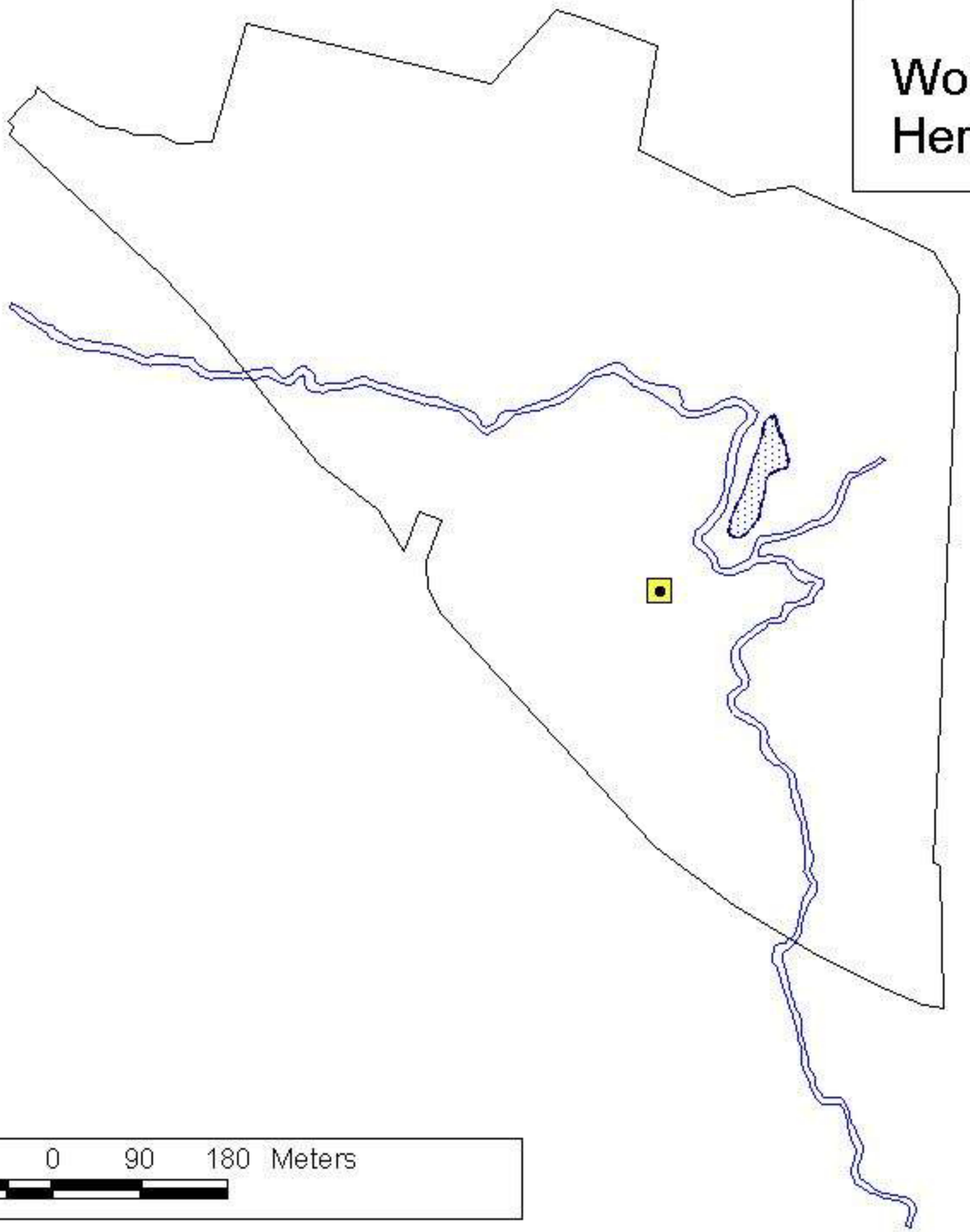
Park Boundary

90 0 90 180 Meters

MBW 5/20/05

Wolf Trap Farm Park
Herpetological Inventories

N



Lizards
- Eumeces fasciatus
- Streams
- Pond
- Park Boundary

90 0 90 180 Meters

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