

# **A Herpetofaunal Inventory of George Washington Carver National Monument**

Stanley E. Trauth<sup>1</sup> and Malcolm L. McCallum<sup>2</sup>

<sup>1</sup>Department of Biological Sciences, Arkansas State University,  
P.O. Box State University, AR 72467-0599

<sup>2</sup>Environmental Sciences Ph.D. Program, P.O. Box 847  
Arkansas State University, State University, AR 72467-0847

April 29, 2003

Technical Report NPS/HTLN/P6370010459

Heartland Network  
Inventory and Monitoring Program  
National Park Service  
6424 W. Farm Rd. 182  
Republic, MO 65738

## Table of Contents

|                            |     |
|----------------------------|-----|
| List of Figures .....      | iii |
| List of Tables .....       | iii |
| Summary .....              | iv  |
| Acknowledgments.....       | v   |
| Introduction.....          | 1   |
| Study Area .....           | 2   |
| Materials and Methods..... | 3   |
| Results.....               | 5   |
| Discussion .....           | 6   |
| Conclusion .....           | 9   |
| Literature Cited .....     | 10  |

## List of Figures

|                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------|----|
| Figure 1. Map of George Washington Carver NM. ....                                                        | 13 |
| Figure 2. Distribution of several species of amphibians and reptiles at George Washington Carver NM. .... | 14 |
| Figure 3. Distribution of several species of amphibians and reptiles at George Washington Carver NM. .... | 15 |
| Figure 4. Distribution of several species of amphibians and reptiles at George Washington Carver NM. .... | 16 |
| Figure 5. Distribution of several species of amphibians and reptiles at George Washington Carver NM. .... | 17 |
| Figure 6. Distribution of several species of amphibians and reptiles at George Washington Carver NM. .... | 18 |

## List of Tables

|                                                                                                                                                                                                                |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1. Herpetofauna documented at George Washington Carver NM (Overdeer 2000a, b). ....                                                                                                                      | 19 |
| Table 2. Species identified at George Washington Carver NM (2001-2002) with their relative abundances on the park grounds. Key: (+++++) = common in all appropriate habitats, (+) = rare throughout park. .... | 21 |
| Table 3. List of amphibians expected and current status of occurrence at George Washington Carver NM. ....                                                                                                     | 22 |
| Table 4. List of reptiles expected and current status of occurrence at George Washington Carver NM. ....                                                                                                       | 23 |

## Summary

No information on current species composition, distribution, and abundance existed for the George Washington Carver NM prior the inventory. Information is needed for park managers to make appropriate decisions to ensure the long-term sustainability of species and abide by the National Park Service (NPS) mission statement. Surveys were conducted in the summer and fall of 2001 and spring and summer of 2002 via cover boards, general search and seizure, road cruising, and pond spot lighting. Aquatic methods included dip netting, seining, and the use of turtle traps. An expected species list incorrectly listed 23 amphibians and 54 reptiles due to incorrect species range and/or habitat requirements. Upon revising this list, the inventory yielded 67% of the amphibians (8 of 12) and 71% of the reptiles (17 of 24). George Washington Carver NM possesses a typical prairie herpetofaunal community as well as some of the more common deciduous forest species. However, some species are absent due to lack of, or marginal, habitat. One voucher displaying typical phenotypic variation for each species was collected. Management implications and recommendations identify possible steps to ensure the long-term sustainability of herpetofauna at George Washington Carver NM.

## Acknowledgments

The authors wish to thank the staff at George Washington Carver NM for their kindness and willing support of the project. Thanks also go to the National Park Service' Heartland Network Inventory and Monitoring Program and Regional Offices who funded the project and to staff who assisted with project logistics. We also thank Ben Ball, Vernon Hoffman, Robyn Konvalinka, Charles McDowell, Bobby Neal, and Ben Wheeler for their field assistance.

## Introduction

In 1998 Congress passed the National Parks Omnibus Management Act in response to concerns about the condition of natural resources within the national parks. The act requires each park to gather baseline inventory data on pertinent natural resources, data that will provide a pivotal step toward establishing an effective monitoring program furthering the ability to effectively manage and protect park resources. The National Park Service (NPS) responded with the Natural Resource Challenge program, including the establishment of biome-based inventory and monitoring networks. The Heartland Network, as part of the NPS Inventory and Monitoring (I&M) program, has undertaken inventories of vascular plants and vertebrates within fifteen parks in eight Midwestern states.

Much of the natural habitat in southwestern Missouri has been modified and/or fragmented by agriculture-alterations implicated as primary factors influencing amphibian declines (Blaustein et al. 1994; Pechmann and Wilbur 1994), and biodiversity declines in general (Heywood 1992). Many amphibian and reptile populations are best described as metapopulations (Levins 1969; Hanski and Gilpin 1997) whose stability is dependent on a balance between population extirpation and recolonization (Johnson et al. 2002). Pollution and introduced species are considered to be major contributors to biodiversity declines (Stebbins and Cohen 1995).

Stemming from this habitat alteration, the Natural Resource Challenge, and a widespread concern regarding the status of herpetofaunal populations at George Washington Carver NM, an inventory was deemed necessary to determine resident amphibians and reptiles. Overdeer (2000a, b) conducted a herpetofaunal survey of the park from 1998-2000 and recorded 35 species including 13 amphibians (10 anurans and three salamanders) and 22 reptiles (six turtles, five lizards, and 11 snakes) (Table 1). Inventories of this type are important, because they allow researchers an opportunity to examine any changes in populations over time. Trends in population dynamics can then be accurately documented and interpreted. In this way natural resource managers can use this information to make informed decisions and conduct appropriate management activities that will insure the continued survival and integrity of the communities present on these lands.

We conducted a thorough, one-year herpetofaunal survey in 2001-2002. The inventory had three objectives: 1) document at least 90% of the amphibian and reptile species reasonably expected to occur at George Washington Carver NM (Tables 3&4) and provide an up-to-date assessment of species richness; 2) estimation of relative abundance and local ranges; and 3) collection and deposition of voucher specimens.

## Study Area

George Washington Carver National Monument is located in Newton County, MO in the Springfield plateau in the southwest corner of the state. Topography consists of gently rolling uplands dissected by stream channels that carry water from natural springs and excess water during rainy periods. A soil covering of several feet in thickness is present nearly everywhere, with Hagerstown and Eldon silt loams and Baxter gravelly loam being predominant in the park. The park is roughly rectangular-shaped encompassing approximately 85 ha (210 acres). Habitat is dominated by xeric prairie and hardwood forest. Approximately 130 acres of the park are in various stages of restoration to native tallgrass prairie. The park's woodlands are small in area, with the total acreage being approximately 60 acres. The remaining 20 acres of the park are in the "development subzone" and encompass areas surrounding the administrative/housing and visitor center/maintenance complexes. Three small streams occur in the park; Carver, Harkins, and Williams. The latter two flow into Carver Branch, which is a tributary of Shoal Creek. Several areas of the park experience wet conditions throughout much of the year. The south central, west central and east central (just east of Williams pond) portions often have standing water during the winter and spring. Some of the water results from runoff, while much of it results from groundwater seepage. In comparison to the surrounding area, the land within the park does not stand out in distinct contrast. The surrounding farmlands all possess somewhat of a mosaic pattern: alternating grassland pastures and forest. Management efforts of approximately 80 acres for restoration to native prairie include seeding, planting, mowing, haying, and prescribed burning. In the past three years, restoration efforts have consisted mainly of mowing, haying, and prescribed burning. These areas are now in a variety of stages of restoration to native prairie. Control of exotic species in both the park's woodland and prairie areas is also a large concern.

## Materials and Methods

The inventory began during the summer 2001 and extended into the summer of 2002 (9-11 July 2001, 28 September 2001, 9 March 2002, 27 April 2002, and, 22-23 May 2002, 21 June 2002). Inventories usually conducted by 2-7 member teams.

Terrestrial inventory methods included road cruising (Karns 1986) and general search and seizure methods (Vogt and Hine 1982) whereas aquatic methods included dip netting and seining (Karns 1986), spotlighting, and the use of turtle traps (Legler 1960). Most common and scientific names are based on Moriarty (2000).

A sampling grid consisted of primary and secondary points for George Washington Carver NM (Figure 1). At each primary point, four secondary points were identified in each primary cardinal compass direction. Cover board use, adapted from Grant et al. (1992), utilized two wood and two tin cover boards placed at each secondary point (to account for potential differences in cover board quality as herpetofaunal attractants).

Thirteen of the 17 primary points were designated as cover board plots and were visited at least once. The four primary points not surveyed consisted of three in heavily wooded areas and one in a lawn area. Time-area constrained searches (TACS) were performed at these four points. The TACS technique was a modification of the “time constrained search and seizure method” and the “quadrant search and seizure” methods utilized by Campbell and Christman (1982). Four secondary points were designated as described above and an 8 m<sup>2</sup> plot was delineated at each secondary point and searched systematically for 10 minutes. All logs, rocks, and other debris were returned to their original position after turning.

Each primary point was recorded using a Trimble GeoExporer 3 Global Positioning System (GPS) portable hand-held unit at the highest accuracy possible. No less than 150 readings were collected for each primary point, and these saved as a single file for each grid point.

Generalized search and seizure methodology (Vogt and Hine 1982) was utilized throughout the entire park. All trails and east-west/north-south transects between cover board plots were hiked. Both day and night road cruising were implemented on all park roads, and roads immediately adjacent to the park. Animals were recorded as they were encountered.

Turtle trapping (Legler 1960) was performed in Carver Pond on 22-23 May 2002. The water depth in the streams was too shallow to adequately sample with traps. Dip netting (Karns 1986) was implemented in ditches and streams throughout the park and in the prairie depression (Figure 1). Carver Spring was inspected through hand searching (Vogt and Hine 1982) and dip netting. At this location the stones were carefully turned and then repositioned in their original setting. The gravel streambed running from Carver Spring was kicked and dip netted. The dip net was held immediately down current so that organisms in the gravel would be carried into the net.

Spotlighting was used at Carver Pond to observe frogs and other herpetofauna. The eye-shine from these animals is easily seen using a spotlight or high-intensity flashlight. These lights are

also useful to capture amphibians and reptiles at night because the light prevents the animal from seeing the investigator's approach.

An expected species list (Boetsch et al. 2000) was revised based on species documented via this inventory and the authors' professional opinion.

A series of northern cricket frogs from Carver Pond were examined for abnormalities and then released back into the pond. Five of these were vouchered with permission of park personnel. Otherwise, a single voucher specimen of each species was taken during the inventory. Specimens prepared for museum storage were body positioned, fixed in 10% formalin, and preserved in 70% ethanol following Pisani (1973). All specimens were deposited in the National Park Service Heartland Division Special Collection within the Arkansas State University Museum of Zoology herpetology collection. Specimen accession numbers were entered into a Microsoft Access database for reference.

## Results

### Expected Species

Twenty-three amphibians and 54 reptiles were listed in the original expected species list (Tables 3 & 4). After the inventory it was determined that 11 amphibians and 30 reptiles were listed in error and that 67% of the amphibians (8 of 12) and 71% of the reptiles (17 of 24) were documented from the Boestch et al (2000) list.

### Species Richness and Abundance

George Washington Carver NM possesses a typical prairie herpetofaunal community (Table 2) as well as some of the more common deciduous forest species. The inventory yielded eight amphibian species (one salamander and seven anurans) and 17 reptilian species (four turtles, five lizards, and eight snakes). Four species were represented by a single observation or specimen. These were the central newt (*Notophthalmus viridescens*), broadhead skink (*Eumeces laticeps*), western slender glass lizard (*Ophisaurus attenuatus attenuatus*), bull snake (*Pituophis catenifer*), and the rough green snake (*Opheodrys aestivus*). The southern coal skink (*Eumeces anthracinus pluvialis*), also represented by a single observation, was an addition to the park herpetofauna list. Of the species previously identified at the park, only 74% were evident in the present study. We were unable to verify eleven species (five amphibians and six reptiles) at George Washington Carver NM that had been observed by Overdeer (2000a, b; Table 3). The estimated relative abundance for each species is provided in table 2.

Carver Pond, both streams, and the surrounding wooded areas had the highest diversity and populations of all sites on the park. Range maps for each species observed on the park and some important nesting areas are provided in figures 2-6.

## Discussion

### Expected Species

Twelve expected amphibian species were incorrectly listed based on habitat. These include three that possibly occur at nearby ponds (considered transients): the eastern tiger salamander (*Ambystoma tigrinum*; documented by Overdeer 2000a), crawfish frog (*Rana areolata*), and green frog (*Rana clamitans*). The latter two were also not found by Overdeer (2000a). Due to the lack of ponds for these, all should be excluded as residents at the park.

The pickerel frog (*Rana palustris*) had been listed as expected but should also be considered a possible transient. Habitat does not exist for the longtail salamander (*Eurycea longicauda*), whereas seven other species do not occur due to non-conducive habitat. These include the smallmouth salamander (*Ambystoma texanum*), cave salamander (*Eurycea lucifuga*) typically found in springs, mudpuppy (*Necturus maculosus*) usually found in deeper streams, Oklahoma salamander (*Eurycea tynnerensis*) absent due to fish predation, zigzag salamander (*Plethodon angusticlavius*), graybelly salamander (*Eurycea multiplicata griseogaster*), and grotto salamander (*Typhlotriton spelaeus*). No larvae were found for the graybelly salamander a typical spring flow inhabitant. This species can be found in the flow between the spring and the stream proper. Underground systems may introduce some animals to the stream flow but since this flow is short (10-15 ft), animals do not persist. The grotto salamander was documented at the park by Overdeer (2001a); yet the habitat, one spring, was represented by little more than a mud hole at the beginning of the inventory (in the spring of 2002 it was free flowing). Drought conditions in recent years may have extirpated this species or the population may have followed the subterranean ground water system and has not had sufficient time to return to the surface. Additionally, the construction of wooden walkways immediately adjacent to the spring may have negatively impacted the population as well.

Although not observed by researchers conducting the inventory, the northern spring peeper (*Pseudacris crucifer*) was observed by park staff.

Eight reptile species were incorrectly listed as expected based on range and include three that do not occur in the region: the false map turtle (*Graptemys pseudogeographica*), western diamondback (*Crotalus atrox*), and the lined snake (*Tropidoclonion lineatum*); two that do not occur in western Missouri: the Missouri slider (*Pseudemys floridana*), Mississippi map turtle (*Graptemys kohnii*); and three that do not occur in the county: the Great Plains rat snake (*Elaphe guttata*), Graham's crayfish snake (*Regina grahami*), and the smooth snake (*Virginia valeriae*).

Twelve reptiles were incorrectly listed as expected but do not occur due to lack of habitat include: the river cooter (*Pseudemys concinna*) which prefers larger waters, the yellow mud turtle (*Kinosternon flavescens*) which prefers large streams, ground snake (*Sonora semiannulata*), flathead snake (*Tantilla gracilis*), six-lined racerunners (*Cnemidophorus sexlineatus*), smooth softshell (*Apalone mutica*), redbelly snake (*Storeria occipitomaculata*) which has limited forested habitat at the park and is uncommon westward in Missouri-- the eastern collared lizard (*Crotaphytus collaris*), the timber rattlesnake (*Crotalus horridus*), alligator snapping turtle (*Macrochelys temminckii*; syn. *Macrochelys t.*), diamondback water

snake (*Nerodia rhombifer*). Each of these species was not documented by Overdeer (2000b). The rough green snake (*Opheodrys aestivus*) was reported by Overdeer (2000b) and Jones (1992-97) but was not observed in this study. The smooth softshell was reported by Angle (1985) but was probably a misidentification.

Eleven reptiles absent due to non-conducive habitat include: the cottonmouth (*Agkistrodon piscivorus*), Texas horned lizards (*Phrynosoma cornutum*) (although documented in counties to the north and south), Great Plains skink (*Eumeces obsoletus*) possible only in exposed rock (the only possible exposed rock at the park were gravestones and a rock retaining wall), rough earth snake (*Virginia striatula*), map turtle (*Graptemys geographica*), musk turtle (*Sternotherus odoratus*), milk snake (*Lampropeltis triangulum*), and speckled kingsnake (*Lampropeltis getula*). The painted turtle (*Chrysemys picta*), spiny softshell (*Apalone spinifera*), and brown snake (*Storeria dekayi*) were reported by Overdeer (2000b) but not observed in this study. The milk snake, speckled kingsnake, and spiny softshell were documented by Jones (1992-97).

County records exist for the western worm snake (*Carphophis vermis*), eastern hognose snake (*Heterodon platirhinos*), eastern coachwhip (*Masticophis flagellum*) but were not documented by this study. Additionally, the western ribbon snake (*Thamnophis proximus*) was not found but had been documented by Overdeer (2001b). The northern copperhead (*Agkistrodon contortrix*) and fence lizard (*Sceloporus undulatus*) were not found but had been documented by park staff (Jones 1992-97).

#### Species Richness and Abundance

The herpetofauna of George Washington Carver NM is represented by a blend of forest and prairie species. Overall, forest dwelling amphibians and reptiles were more common than any of the prairie species. The bullsnake, western slender glass lizard, and ornate box turtle are endemics to xeric prairie regions (O'Connell 1992; McCallum and Moll 1994). These three species were rarely encountered. Surprisingly, common forest-dwelling species (e.g., the northern fence lizard, *Sceloporus undulatus hyacinthinus* and the western worm snake, *Carphophis vermis*) were not observed at the park; other species (e.g., the southern coal skink, *Eumeces anthracinus pluvialis*) were rare when compared to our observations in national forests in the Interior Highlands region. This may partly result from habitat alteration by exotic vegetation, such as the introduced honey suckle (*Lonicera* spp.) and multiflora rose (*Rosa multiflora*). The changes in microhabitat dynamics on the forest floor as these invasives persist and spread could dramatically suppress many species of amphibians and reptiles.

The small size of this park may also explain its lower diversity. Island biogeography suggests that species diversity is strongly tied to the area of an ecological island (MacArthur and Wilson 1967). It is possible that the area of the park is simply too small to maintain diverse herpetofaunal communities over the long term.

We did not observe Cope's gray treefrog or the eastern tiger salamander at the park. These species are probably transients here. Immediately across the highway from the park are several small farm ponds; one had an abundance of Cope's gray treefrog and other anuran species breeding on it (Figs. 3, 4, and 6). Eastern tiger salamanders undoubtedly breed in these ponds as well, although we did not have the opportunity to verify their presence. Fishless ephemeral

ponds are essential for maintaining these species' populations. No ponds of this nature are present at the park and, thus, prevent the establishment of breeding populations of several species within the park's boundary.

Carver Spring was reported to possess a population of grotto salamanders. When our study began, this spring was represented by little more than a mud hole. In the spring of 2002, however, the spring was free flowing. Drought conditions in recent years may have extirpated this species from the park. Alternatively, the population may have followed the subterranean ground water system and has not had sufficient time to return to the surface. Additionally, the construction of wooden walkways immediately adjacent to the spring may have negatively impacted the population as well. The fact that northern cricket frogs were abundant in other aquatic habitats in the park, but were absent from the area around Carver Spring is suspicious. Cricket frogs are commonly encountered along springs; consequently, because large populations of this species are in the vicinity (e.g., Carver Pond), we would expect to find them at this spring as well. No other amphibian species were present in the spring either, although ranid tadpoles (e.g., bullfrog, green frog, and southern leopard frog) were observed in the nearby stream. These ranids are believed to be fairly resistant to pollution.

Species richness is the variety of species present in an area without consideration of their abundance. Species richness is believed to decrease when ecological integrity is compromised (Feinsinger 2001). The use of species richness indexes alone, without adequate consideration of abundance, can lead to incorrect decisions regarding natural resource management (Feinsinger 2001). It is important for continued long-term monitoring to occur at the park so that the accuracy and precision of the resultant data set support good decision-making. Our study is primarily a species inventory and provides limited abundance information. Further studies on the herpetofaunal communities at the park will insure adequate information for appropriate administrative planning regarding this park's herpetofaunal resources.

## Conclusion

- 1) Construct several temporary wildlife ponds to establish resident eastern tiger salamander and Cope's gray treefrog populations. This should be implemented both in the wooded and prairie areas. This would also benefit all species of amphibians as well as other wildlife on the park grounds. Translocation of eastern tiger salamander larvae and other local salamanders might be beneficial.
- 2) The prairie habitats should be considered a special biological resource on the park and should be closely monitored. Further investigation regarding the influence of this park's size on herpetofaunal diversity is warranted.
- 3) Timber management should include a debris management plan so that a sufficient number of fallen logs and other potential refugia are available as amphibian and reptilian habitat.
- 4) The dump area on the park is an important nesting site for terrestrial reptiles. The piles of vegetation, boards, and dirt are utilized by several species of reptiles.
- 5) The forest floor is severely in need of vegetation management to destroy introduced honey suckle and multiflora rose. Non-herbicide control practices should be used near Carver Spring to protect the grotto salamander population.
- 6) Continued long-term monitoring of George Washington Carver NM herpetofauna populations especially is essential.

## Literature Cited

- Angle, B. 1985. Survey of the reptilian populations at George Washington Carver National Monument. Diamond, Missouri.
- Blaustein, A.R., D.B. Wake, and W.P. Sousa. 1994. Amphibian declines: Judging stability, persistence, and susceptibility of populations to local and global extinctions. *Conservation Biology* 8:60-71.
- Boetsch, J.; DeBacker, M.; Hughes, P.; Peitz, D.; Thomas, L.; Wagner, G.; Witcher, B. 2000. A study plan to inventory vascular plants and vertebrates: Heartland Network, National Park Service.
- Campbell, H.W. and S.P. Christman. 1982. Field techniques for herpetofaunal community analysis. Pp. 193-200 In: Scott, N.J., Jr. (ed.), *Herpetological Communities*. Wildlife Research Report 13, Fish and Wildlife Service, U.S. Department of the Interior.
- Feinsinger, P. 2001. *Designing Field Studies for Biodiversity Conservation*. Island Press. Washington, D.C. 212 pp.
- Grant, B.W., A.D. Tucker, J.E. Lovich, A.M. Mills, P.M. Dixon, and J.W. Gibbons. 1992. The use of coverboards in estimating patterns of reptile and amphibian biodiversity. Pp. 379-403 In: D.R. McCullough and R.H. Barnett (eds.). *Wildlife 2001*. Elsevier Science Publications. London, England.
- Hanski, I.A. and M.E. Gilpin. 1997. *Metapopulation biology: Ecology, genetics, and evolution*. Academic Press. San Diego, CA. 358 pp.
- Heywood, V.H. 1992. *Global Biodiversity Assessment*. Cambridge University Press. New York, NY. 1140 pp.
- Johnson, C.M., L.B. Johnson, C. Richards, and V. Beasley. 2002. Predicting the occurrence of amphibians: An assessment of multiple-scale models. Pp. 157-170 In: Scott, M.J., P.J. Heglund, and M.L. Morrison. *Predicting Species Occurrences: Issues of accuracy and scale*. Island Press. Washington, D.C.
- Karns, D.R. 1986. *Field Herpetology: Methods for the Study of Amphibians and Reptiles in Minnesota*. University of Minnesota James Ford Bell Museum of Natural History Occasional Paper 18:1-88
- Jones, B. 1992-97. Photos documenting herpetofauna at George Washington Carver NM.
- Legler, J.M. 1960. A simple and inexpensive device for trapping aquatic turtles. *Utah Academy of Science Proceedings* 37:63-66.
- Levins, R. 1969. Some demographic and genetic consequences of environmental heterogeneity for biological control. *Bulletin of the Entomological Society of America* 15:237-240
- MacArthur, R.H. and E.O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton University Press. Princeton, NJ.
- McCallum, M.L. and E. O. Moll. 1994. *Herpetological inventory of the upland habitats of the Savanna Army Depot*. Unpublished report to the US Fish and Wildlife Service. 27 pp.
- Moriarty, J.J. 2000. Scientific and standard common English names of amphibians and reptiles of North America north of Mexico with comments regarding confidence in our understanding. *Herpetological Circular* 29:1-89

- O'Connell, D.J. 1992. A herpetofaunal survey of the Braidwood Dunes and Savanna Nature Preserve. Unpublished Master's Thesis. Eastern Illinois University. 54 pp.
- Overdeer, D. 2000a. Amphibians of George Washington Carver National Monument. Unpublished Report to the George Washington Carver National Monument, United States Department of the Interior. 7 pp.
- Overdeer, D. 2000b. Reptiles of George Washington Carver National Monument. Unpublished Report to the George Washington Carver National Monument, United States Department of the Interior. 8 pp.
- Pechmann, J.H.K., and H.M. Wilbur. 1994. Putting declining amphibian populations in perspective: Natural fluctuations and human impacts. *Herpetologica* 50:65-84
- Pisani, G.R. 1973. A Guide to Preservation Techniques for Amphibians and Reptiles. Herpetological Circular No. 1., Society for the Study of Amphibians and Reptiles. St. Louis, MO.
- Stebbins, R. C. and N. W. Cohen. 1995. A Natural History of Amphibians. Princeton University Press, Princeton, NJ. xvi + 316 pp.
- Vogt, R.C. and R.L. Hine. 1982. Evaluation of techniques for the assessment of amphibian and reptile populations in Wisconsin. Pp. 201-217 In: Scott, N.J., Jr. (ed.), *Herpetological Communities*. Wildlife Research Report 13, Fish and Wildlife Service, U.S. Department of the Interior.



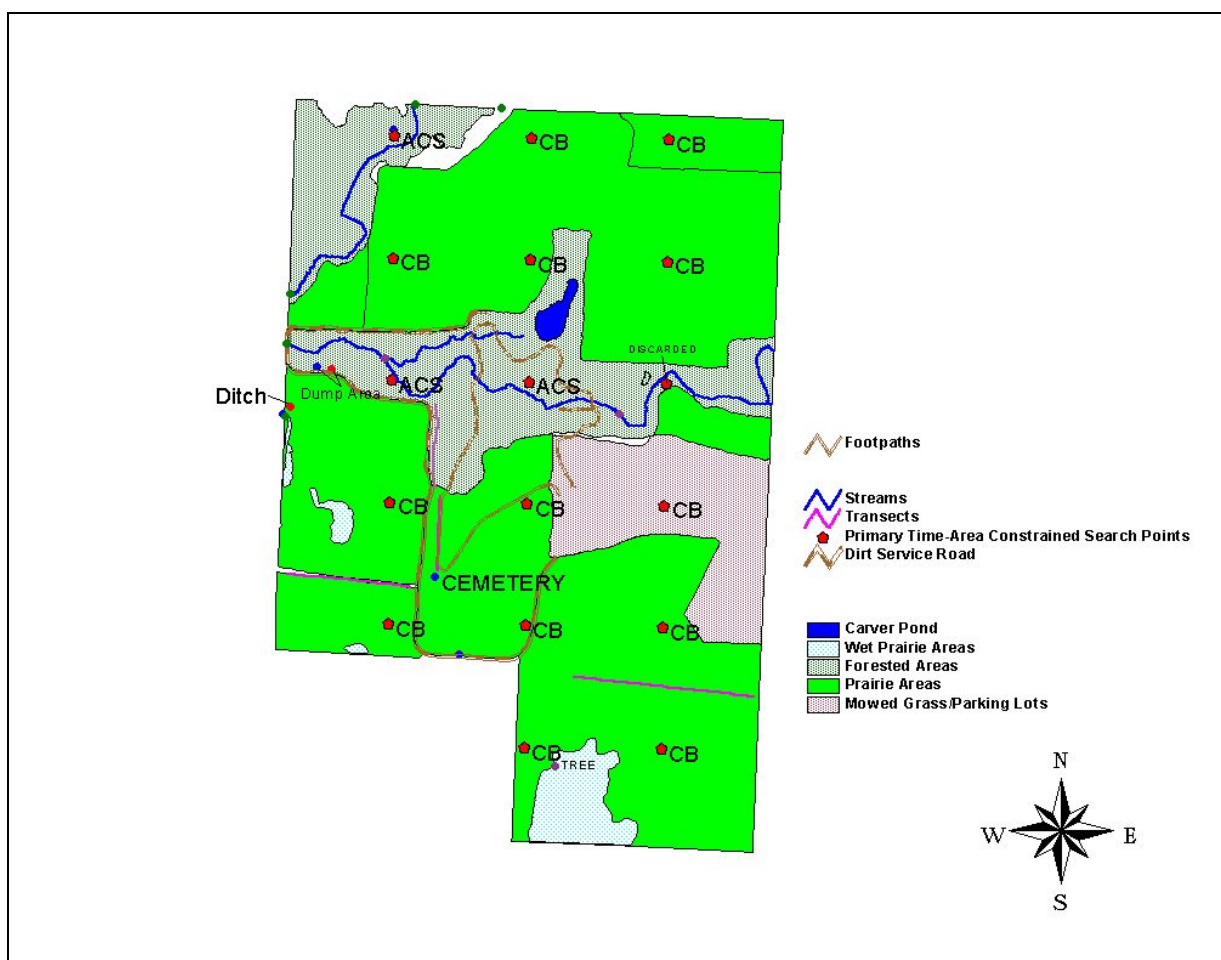


Figure 1. Map of George Washington Carver NM.

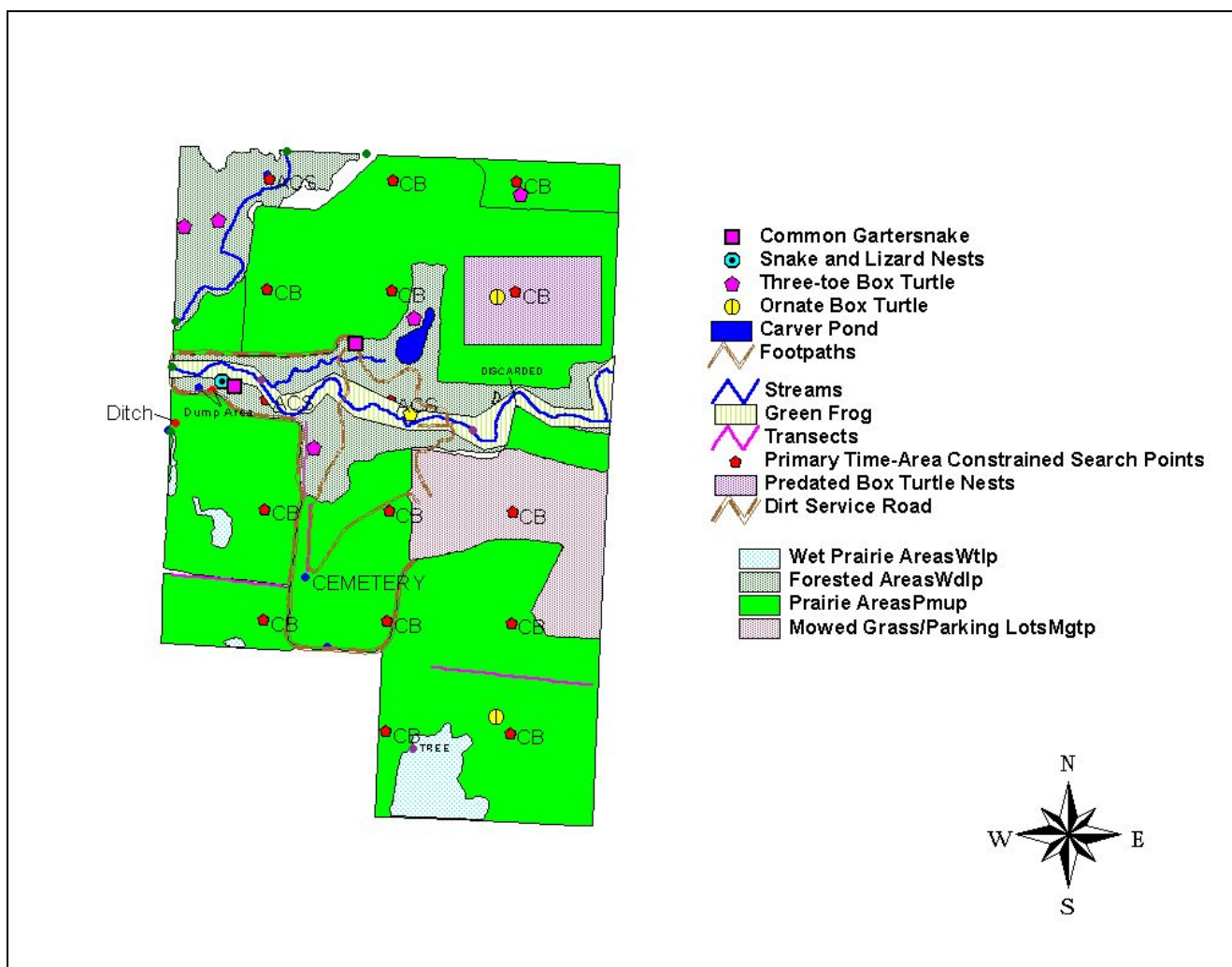


Figure 2. Distribution of several species of amphibians and reptiles at George Washington Carver NM.

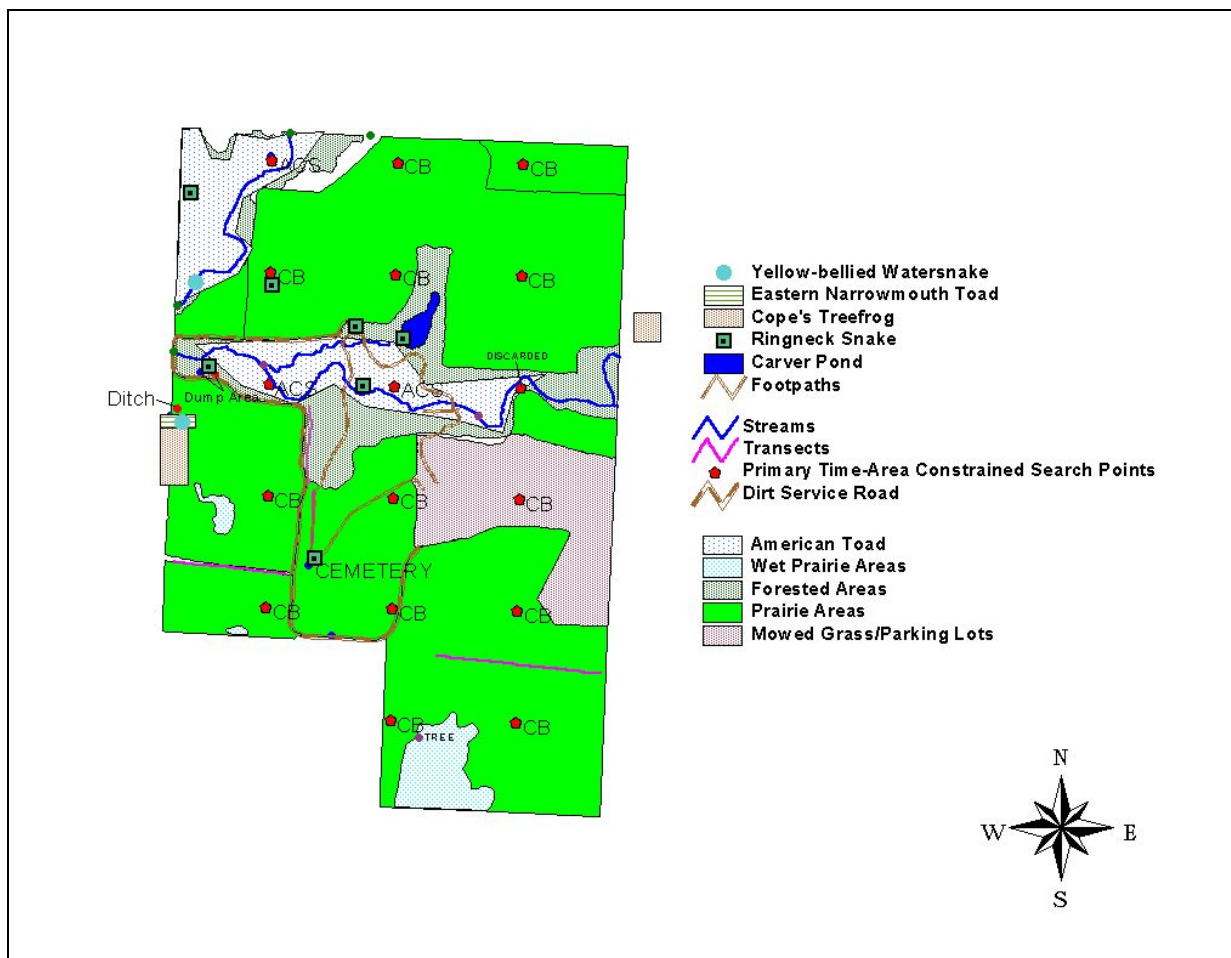


Figure 3. Distribution of several species of amphibians and reptiles at George Washington Carver NM.

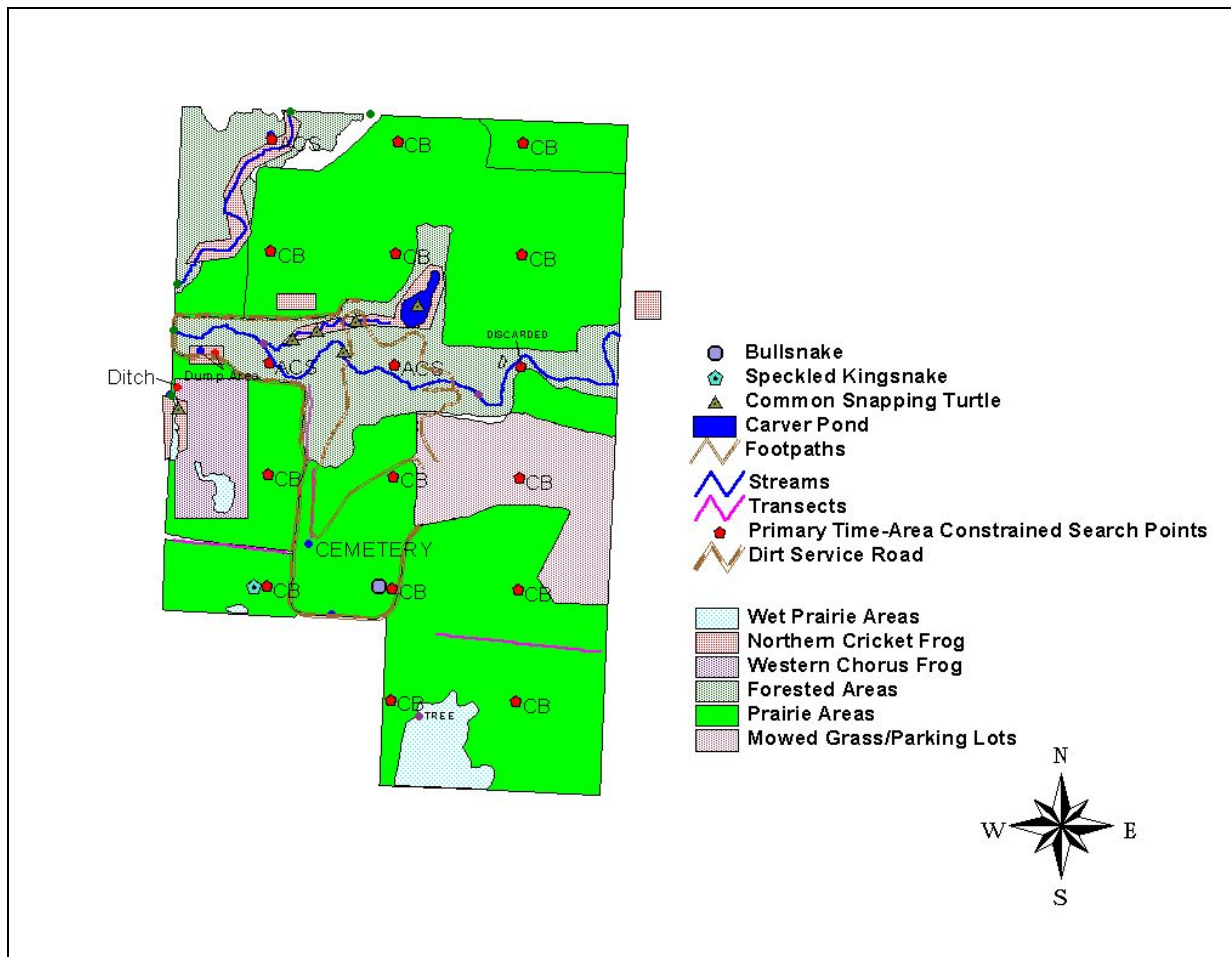


Figure 4. Distribution of several species of amphibians and reptiles at George Washington Carver NM.

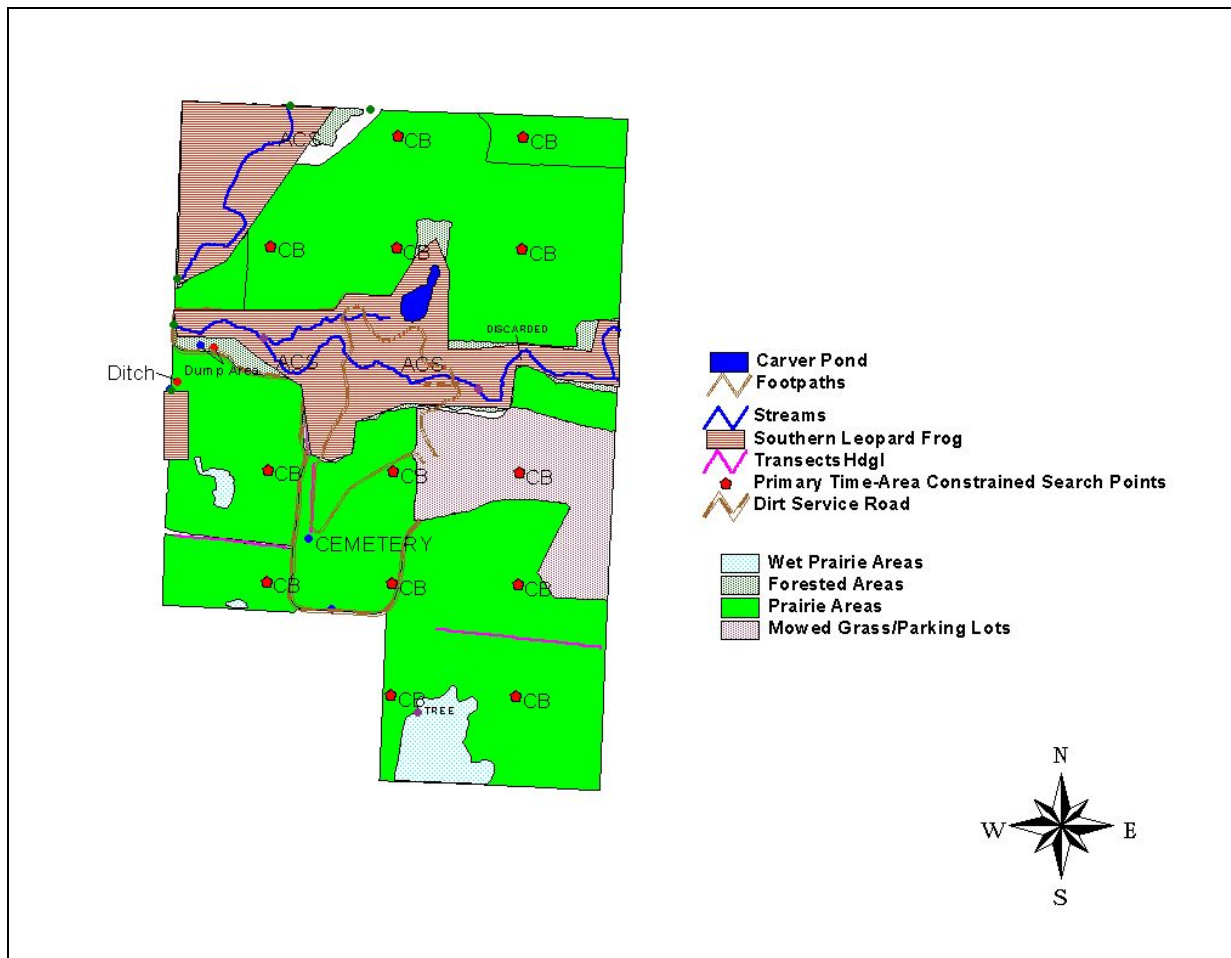


Figure 5. Distribution of several species of amphibians and reptiles at George Washington Carver NM.

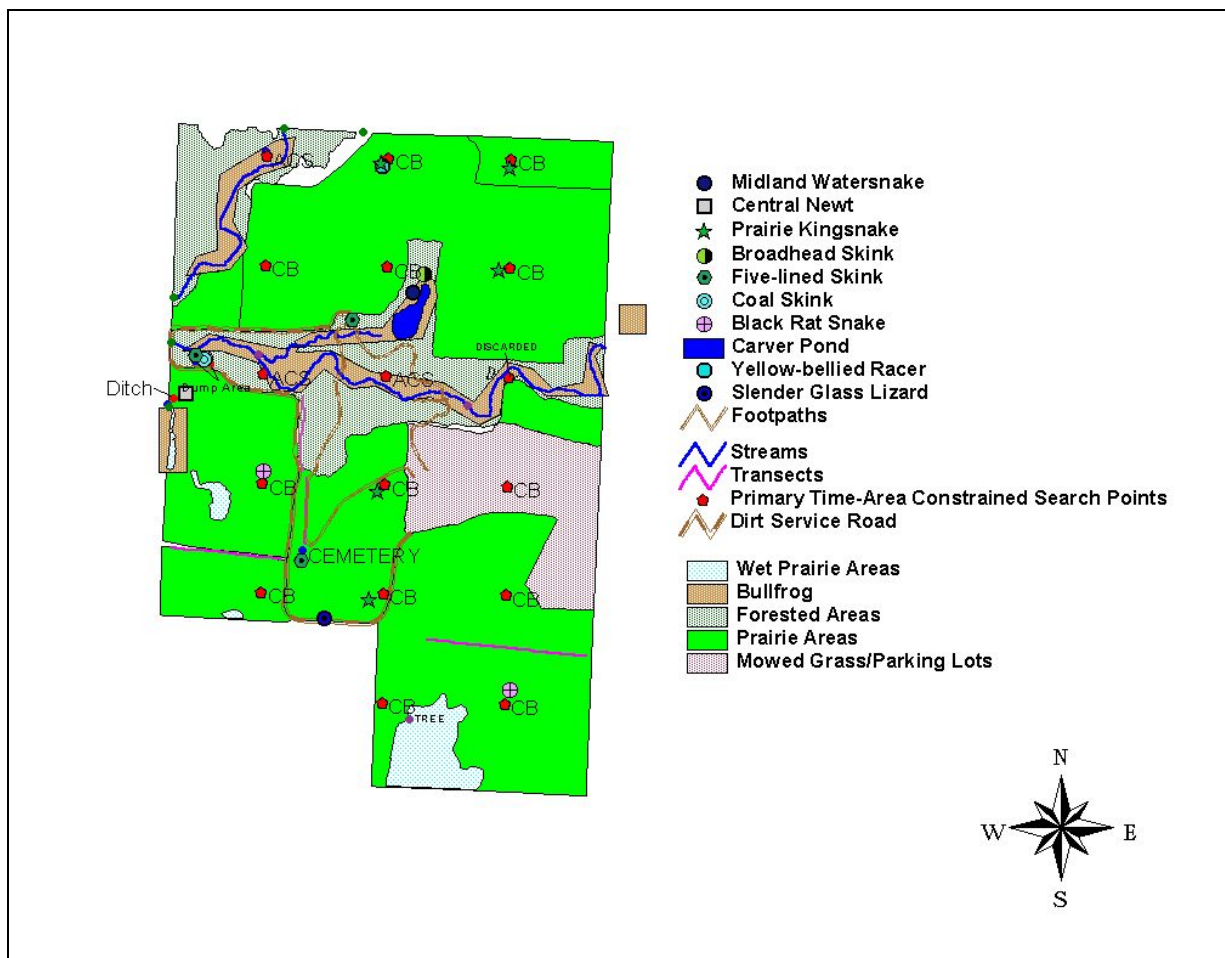


Figure 6. Distribution of several species of amphibians and reptiles at George Washington Carver NM.

Table 1. Herpetofauna documented at George Washington Carver NM (Overdeer 2000a, b).

|                                   |                                            |                              |
|-----------------------------------|--------------------------------------------|------------------------------|
| <b>Class Amphibia</b>             |                                            |                              |
| <b>Order Anura</b>                | <b>Scientific Name</b>                     | <b>Common Name</b>           |
| Bufonidae                         | Bufo americanus charlesmithi               | Dwarf American toad          |
|                                   | Bufo fowleri                               | Fowler's toad                |
| Hylidae                           | Acris crepitans blanchardi                 | Blanchard's cricket frog     |
|                                   | Hyla chrysoscelis/versicolor               | Gray treefrog                |
|                                   | Pseudacris crucifer crucifer               | Northern spring peeper       |
|                                   | Pseudacris triseriata triseriata           | Western chorus frog          |
| Microhylidae                      | Gastrophryne carolinensis                  | Eastern narrowmouth toad     |
| Ranidae                           | Rana catesbeiana                           | Bullfrog                     |
|                                   | Rana palustris                             | Pickerel frog                |
|                                   | Rana sphenoccephala                        | Southern leopard frog        |
| <b>Order Caudata</b>              |                                            |                              |
| Ambystomatidae                    | Ambystoma tigrinum tigrinum                | Eastern tiger salamander     |
| Plethodontidae                    | Typhlotriton spelaeus                      | Grotto salamander            |
| Salamandridae                     | Notophthalmus viridescens<br>louisianensis | Central newt                 |
| <b>Class Reptilia</b>             |                                            |                              |
| <b>Order Squamata; Lacertilia</b> |                                            |                              |
| Anguidae                          | Ophisaurus attenuatus attenuatus           | Western slender glass lizard |
| Phrynosomatidae                   | Sceloporus undulatus hyacinthinus          | Northern fence lizard        |
| Scincidae                         | Eumeces fasciatus                          | Five-lined skink             |
|                                   | Eumeces laticeps                           | Broadhead skink              |
|                                   | Scincella lateralis                        | Ground skink                 |
| <b>Order Squamata; Serpentes</b>  |                                            |                              |
| Colubridae                        | Coluber constrictor flaviventris           | Eastern yellowbelly racer    |
|                                   | Diadophis punctatus arnyi                  | Prairie ringneck snake       |
|                                   | Elaphe obsoleta obsoleta                   | Black rat snake              |
|                                   | Lampropeltis calligaster                   | Prairie kingsnake            |
|                                   | Nerodia sipedon pleuralis                  | Midland water snake          |
|                                   | Opheodrys aestivus                         | Rough green snake            |
|                                   | Pituophis catenifer sayi                   | Bullsnake                    |
|                                   | Storeria dekayi wrightorum                 | Midland brown snake          |
|                                   | Thamnophis proximus                        | Western ribbon snake         |
|                                   | Thamnophis sirtalis parietalis             | Red-sided garter snake       |
| Viperidae                         | Agkistrodon contortrix phaeogaster         | Osage copperhead             |

Table 1. Herpetofauna documented at George Washington Carver NM (cont.).

| <b>Order Testudines</b> | <b>Scientific Name</b>              | <b>Common Name</b>      |
|-------------------------|-------------------------------------|-------------------------|
| Chelydridae             | <i>Chelydra serpentina</i>          | Common snapping turtle  |
| Emydidae                | <i>Chrysemys picta belli</i>        | Western painted turtle  |
|                         | <i>Terrapene carolina triunguis</i> | Three-toed box turtle   |
|                         | <i>Terrapene ornata</i>             | Ornate box turtle       |
|                         | <i>Trachemys scripta</i>            | Red-eared slider        |
| Trionychidae            | <i>Apalone spinifera hartwegi</i>   | Western spiny softshell |

Table 2. Species identified at George Washington Carver NM (2001-2002) with their relative abundances on the park grounds. Key: (+++++) = common in all appropriate habitats, (+) = rare throughout park.

| <b>Class Amphibia</b>   | <b>Scientific Name</b>                  | <b>Common Name</b>      | <b>Relative Abundance</b> |
|-------------------------|-----------------------------------------|-------------------------|---------------------------|
| <b>Order Caudata</b>    |                                         |                         |                           |
| Salamandridae           | Notophthalmus viridescens louisianensis | Central newt            | +                         |
| <b>Order Salienta</b>   |                                         |                         |                           |
| Bufonidae               | Bufo americanus                         | American toad           | ++                        |
| Hylidae                 | Acris crepitans                         | Northern cricket frog   | ++++                      |
|                         | Hyla chrysoscelis                       | Cope's gray treefrog    | +                         |
|                         | Pseudacris triseriata                   | Upland chorus frog      | ++                        |
| Microhylidae            | Gastrophryne carolinensis               | W. narrowmouth toad     | +++                       |
| Ranidae                 | Rana catesbeiana                        | American bullfrog       | +++++                     |
|                         | Rana sphenoccephala                     | Southern leopard frog   | +++++                     |
| <b>Class Reptilia</b>   |                                         |                         |                           |
| <b>Order Squamata</b>   |                                         |                         |                           |
| Anguidae                | Ophisaurus attenuatus attenuatus        | W. slender glass lizard | +                         |
| Colubridae              | Coluber constrictor flaviventris        | E. yellowbelly racer    | +++                       |
|                         | Diadophis punctatus                     | Ringneck snake          | +++++                     |
|                         | Elaphe obsoleta                         | Western rat snake       | +++                       |
|                         | Lampropeltis calligaster calligaster    | Prairie kingsnake       | ++                        |
|                         | Nerodia erythrogaster                   | Yellowbelly water snake | ++++                      |
|                         | Nerodia sipedon pleuralis               | Midland water snake     | +                         |
|                         | Pituophis catenifer                     | Bullsnake               | +                         |
|                         | Thamnophis sirtalis                     | Eastern garter snake    | ++                        |
| Scincidae               | Eumeces anthracinus pluvialis           | Southern coal skink     | +                         |
|                         | Eumeces fasciatus                       | Five-lined skink        | +++                       |
|                         | Eumeces laticeps                        | Broadhead skink         | +                         |
|                         | Scincella lateralis                     | Ground skink            | ++++                      |
| <b>Order Testudines</b> |                                         |                         |                           |
| Chelydridae             | Chelydra serpentina serpentina          | Snapping turtle         | ++++                      |
| Emydidae                | Terrapene carolina triunguis            | Three-toed box turtle   | +++++                     |
|                         | Terrapene ornata ornata                 | Ornate box turtle       | +                         |
|                         | Trachemys scripta elegans               | Red-eared slider        | ++++                      |

Table 3. List of amphibians expected and current status of occurrence at George Washington Carver NM.

| <b>Order Caudata</b>  | <b>Scientific Name</b>                  | <b>Common Name</b>       | <b>Old</b> | <b>New</b> | <b>Trauth</b> |
|-----------------------|-----------------------------------------|--------------------------|------------|------------|---------------|
| Ambystomatidae        | Ambystoma texanum                       | Smallmouth salamander    | 1          | 0          | No            |
|                       | Ambystoma tigrinum                      | Eastern tiger salamander | 1          | 0          | No            |
| Plethodontidae        | Eurycea longicauda                      | Longtail salamander      | 1          | 0          | No            |
|                       | Eurycea lucifuga                        | Cave salamander          | 1          | 0          | No            |
|                       | Eurycea multiplicata griseogaster       | Graybelly salamander     | 1          | 0          | No            |
|                       | Eurycea tynesensis                      | Oklahoma salamander      | 1          | 0          | No            |
|                       | Plethodon angusticlavius                | Zigzag salamander        | 1          | 0          | No            |
|                       | Typhlotriton spelaeus                   | Grotto salamander        | 1          | 4          | No            |
| Proteidae             | Necturus maculosus                      | Mudpuppy                 | 1          | 0          | No            |
| Salamandridae         | Notophthalmus viridescens louisianensis | Central newt             | 1          | 2          | Yes           |
| <b>Order Salienta</b> |                                         |                          |            |            |               |
| Bufonidae             | Bufo americanus                         | American toad            | 1          | 2          | Yes           |
|                       | Bufo woodhousii (=fowleri)              | Woodhouse's toad         | 1          | 1          | No            |
| Hylidae               | Acris crepitans                         | Cricket frog             | 1          | 2          | Yes           |
|                       | Hyla chrysoscelis                       | Gray treefrog            | 1          | 2          | Yes           |
|                       | Pseudacris crucifer                     | Northern spring peeper   | 1          | 2          | No            |
|                       | Pseudacris triseriata                   | Western chorus frog      | 1          | 2          | Yes           |
| Microhylidae          | Gastrophryne carolinensis               | E. narrowmouth toad      | 1          | 2          | Yes           |
|                       | Gastrophryne olivacea                   | W. narrowmouth toad      | 1          | 1          | No            |
| Ranidae               | Rana areolata                           | Crawfish frog            | 1          | 0          | No            |
|                       | Rana catesbeiana                        | Bullfrog                 | 1          | 2          | Yes           |
|                       | Rana clamitans                          | Green frog               | 1          | 0          | No            |
|                       | Rana palustris                          | Pickerel frog            | 1          | 1          | No            |
|                       | Rana utricularia (=sphenoccephala)      | Southern leopard frog    | 1          | 2          | Yes           |

“Old” indicates the status prior the inventory, “New” the status after the inventory, and “Trauth” indicates whether the author vouchered the species. Values for Old and New follow Boetsch et al (2000): a “1” is used to indicate that a given species is expected, “2” indicates that the species was observed (documented within the park), “3” indicates species that were not on the expected species list but were observed, and “4” indicates an extinct or regionally extirpated species.

Table 4. List of reptiles expected and current status of occurrence at George Washington Carver NM.

| Order Squamata  | Scientific Name           | Common Name             | Old | New | Trauth |
|-----------------|---------------------------|-------------------------|-----|-----|--------|
| Anguidae        | Ophisaurus attenuatus     | Slender glass lizard    | 1   | 2   | Yes    |
| Colubridae      | Carphophis vermis         | Western worm snake      | 1   | 1   | No     |
|                 | Coluber constrictor       | Racer                   | 1   | 2   | Yes    |
|                 | Diadophis punctatus       | Ringneck snake          | 1   | 2   | Yes    |
|                 | Elaphe guttata            | Great Plains rat snake  | 1   | 0   | No     |
|                 | Elaphe obsoleta           | Black rat snake         | 1   | 2   | Yes    |
|                 | Heterodon platyrhinos     | Eastern hognose snake   | 1   | 1   | No     |
|                 | Lampropeltis calligaster  | Prairie kingsnake       | 1   | 2   | Yes    |
|                 | Lampropeltis getula       | Speckled kingsnake      | 1   | 2*  | No     |
|                 | Lampropeltis triangulum   | Milk snake              | 1   | 2*  | No     |
|                 | Masticophis flagellum     | Eastern coachwhip       | 1   | 1   | No     |
|                 | Nerodia erythrogaster     | Plainbelly water snake  | 1   | 2   | Yes    |
|                 | Nerodia rhombifer         | Diamondback water snake | 1   | 0   | No     |
|                 | Nerodia sipedon pleuralis | Northern water snake    | 1   | 2   | Yes    |
|                 | Opheodrys aestivus        | Rough green snake       | 1   | 2*  | No     |
|                 | Pituophis catenifer       | Bull snake              | 1   | 2   | Yes    |
|                 | Regina grahamii           | Graham's crayfish snake | 1   | 0   | No     |
|                 | Sonora semiannulata       | Ground snake            | 1   | 0   | No     |
|                 | Storeria dekayi           | Brown snake             | 1   | 0   | No     |
|                 | Storeria occipitomaculata | Redbelly snake          | 1   | 0   | No     |
|                 | Tantilla gracilis         | Flathead snake          | 1   | 0   | No     |
|                 | Thamnophis proximus       | Western ribbon snake    | 1   | 1   | No     |
|                 | Thamnophis sirtalis       | Common garter snake     | 1   | 2   | Yes    |
|                 | Tropidoclonion lineatum   | Lined snake             | 1   | 0   | No     |
|                 | Virginia striatula        | Rough earth snake       | 1   | 0   | No     |
|                 | Virginia valeriae         | Smooth earth snake      | 1   | 0   | No     |
| Crotaphytidae   | Crotaphytus collaris      | Eastern collared lizard | 1   | 0   | No     |
| Phrynosomatidae | Phrynosoma cornutum       | Texas horned lizard     | 1   | 0   | No     |
|                 | Sceloporus undulatus      | Fence lizard            | 1   | 2   | No     |
| Scincidae       | Eumeces anthracinus       | Coal skink              | 1   | 2   | Yes    |
|                 | Eumeces fasciatus         | Five-lined skink        | 1   | 2   | Yes    |
|                 | Eumeces laticeps          | Broadhead skink         | 1   | 2   | Yes    |
|                 | Eumeces obsoletus         | Great Plains skink      | 1   | 0   | No     |
|                 | Scincella lateralis       | Ground skink            | 1   | 2   | Yes    |

Table 4. List of reptiles expected and current status of occurrence at George Washington Carver NM (cont.).

| <b>Order Squamata</b>   | <b>Scientific Name</b>       | <b>Common Name</b>         | <b>Old</b> | <b>New</b> | <b>Trauth</b> |
|-------------------------|------------------------------|----------------------------|------------|------------|---------------|
| Teiidae                 | Cnemidophorus sexlineatus    | Six-lined racerunner       | 1          | 0          | No            |
| Viperidae               | Agkistrodon contortrix       | Northern copperhead        | 1          | 2*         | No            |
|                         | Agkistrodon piscivorus       | Cottonmouth                | 1          | 0          | No            |
|                         | Crotalus atrox               | W. diamondback rattlesnake | 1          | 0          | No            |
|                         | Crotalus horridus            | Timber rattlesnake         | 1          | 0          | No            |
| <b>Order Testudines</b> |                              |                            |            |            |               |
| Chelydridae             | Chelydra serpentina          | Snapping turtle            | 1          | 2          | Yes           |
|                         | Macrochelys temminckii       | Alligator snapping turtle  | 1          | 0          | No            |
| Emydidae                | Pseudemys concinna           | River cooter               | 1          | 0          | No            |
|                         | Pseudemys floridana          | Missouri slider            | 1          | 0          | No            |
|                         | Pseudemys picta              | Painted turtle             | 1          | 0          | No            |
|                         | Graptemys geographica        | Map turtle                 | 1          | 0          | No            |
|                         | Graptemys kohnii             | Mississippi map turtle     | 1          | 0          | No            |
|                         | Graptemys pseudogeographica  | False map turtle           | 1          | 0          | No            |
|                         | Terrapene carolina triunguis | Three-toed box turtle      | 1          | 2          | Yes           |
|                         | Terrapene ornata             | Ornate box turtle          | 1          | 2          | Yes           |
|                         | Trachemys scripta elegans    | Red-eared slider           | 1          | 2          | Yes           |
| Kinosternidae           | Kinosternon flavescens       | Yellow mud turtle          | 1          | 0          | No            |
|                         | Sternotherus odoratus        | Musk turtle (stinkpot)     | 1          | 0          | No            |
| Trionychidae            | Apalone muticus              | Smooth softshell           | 1          | 0          | No            |
|                         | Apalone spinifer             | Spiny softshell            | 1          | 2*         | No            |

\*documented via photo from Jones (1992-97)