

# A HERPETOFAUNAL INVENTORY AT MOCK CREEK NATIONAL BATTLEFIELD

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## Summary

No information on current species composition, distribution, and abundance existed for the park prior the inventory. Info is needed for park managers to make appropriate decisions to ensure the long-term sustainability of species and abide by the NPS mission statement. Surveys were conducted via cover boards and general search (anything else) during when. Twenty-seven herpetofauna species were found, 9 amphibians and 18 reptiles. Several changes were made to an expected species list based on species range and/or habitat requirements. Species richness and abundance was low and is attributed to lack of, or marginal, habitat. One voucher displaying typical phenotypic variation for each species was collected. Three others were collected for possible hybrids. Management implications and recommendations identify possible steps to ensure the long-term sustainability of herpetofauna at Mock Creek NB.

## Acknowledgments

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## 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.

Stemming from this challenge and a widespread concern regarding the status of herpetofauna populations at Mock Creek National Battlefield (NB), an inventory was deemed necessary to determine resident amphibians and reptiles. Due to a wide variety of habitats, Mock Creek NB may provide refuge for some species. Currently, there is no data documenting species composition, distribution, and abundance at the park and an inventory will aid in the development of a herpetofauna monitoring plan.

Much of the natural habitat in western Missouri has been modified/fragmented by agriculture. Habitat fragmentation and alteration have been implicated as primary factors influencing amphibian declines (Pechmann and Wilbur 1994, Blaustein, et al. 1994), and biodiversity declines in general (Heywood 1995). Many amphibian and reptile populations are best described as metapopulations (Levins 1969, Hanski and Gilpin 1991) whose stability is dependent on a balance between population extirpation and recolonization (Johnson et al. 2002). Pollution and introduced species are considered major contributors to biodiversity declines (Stebbins and Cohen 1995). Wilson's Creek is the largest stream at the park and receives large volumes of sewage effluent and is posted as a public health risk. Introduced species such as multiflora rose (*Rosa multiflora*), honeysuckle (*Lonicera* sp.), and sericeous lespedeza (*Lespedeza cuneata*) dominate large areas of the park. Although the habitats at Mock Creek NB are not virgin lands, their setting on the Central Plateau makes Mock Creek NB an important conservation area. Their management to limit disturbance may allow the park to act as an ecological source for refueling adjacent populations (Wiens 1996). Despite its importance as a biodiversity holding, little is known about the park's herpetofauna. Box turtles (*Terrapene* sp.) and grotto salamanders (*Typhlotriton spelaeus*) were previously observed at the park.

The objective of the inventory was to conduct a comprehensive, one-year herpetofauna survey. The study had three objectives: 1) document at least 90% of the amphibian and reptile species reasonably expected to occur at Mock Creek NB (Appendices 1&2) 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

Mock Creek National Battlefield is located 10 miles south of Somewhere, Missouri, in Hokiepoo County in the southwestern corner of the state. The park (Figure 1) encompasses 7080 ha (17,500 acres), which includes approximately 25% of the historic battlegrounds. The Battlefield lies within a karst area along Wilson's Creek approximately 2 miles upstream from its confluence with the Thomas River and is within the upper portion of the 14,960 square mile Thomas River Watershed. There are five caves located within the park totaling approximately 560 feet of undeveloped cave passages. Two caves have been mapped and initial surveys have been made. All caves are closed to the public until a complete inventory of

resources has been completed and staff can make an informed decision about their future management. Recreational use of Mock Creek NB is estimated to be 500,000 visitors annually.

### Materials and Methods

Primary terrestrial inventory activities were road cruising (Karns 1986) and general search and seizure methods (Vogt and Hine 1982). Aquatic methods included dip netting and seining (Karns 1986) and the use of turtle traps (Legler 1960). Common and scientific names are based on Moriarty (2000).

The inventory began during the summer of 2000 and extended into the spring of 2002. The park was visited on 1-3 May 2001, 11-13 June 2001, 9-10 March 2002, 12-14 April 2002, and 22-23 June 2002. A sampling grid of primary and secondary points for Mock Creek NB (Fig. 2) was provided by the NPS Prairie Cluster Long-Term Ecological Monitoring (LTEM) staff. At each primary point, four secondary points were identified in each of the cardinal directions (north, south, east, and west) from the primary point.

Two wood and two tin cover boards were used (adapted from Grant et al. 1992) at each secondary point to account for potential differences in board quality as amphibian and reptile attractants. Cover boards were visited at least once. Forty of the 84 primary points were set as overboard plots, and time-area constrained searches (TACS) were used at the others. If the primary or secondary grid point appeared in a heavily wooded area, then cover boards were not applied, and instead designated that point used for TACS.

The TACS technique was a modification of the “time constrained search and seizure method” and the “quadrant search and seizure;” both methods were employed by Campbell and Christman (1982). Four secondary points, designated as described above, were identified. 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 located using a Trimble GeoExplorer 3 Global Positioning System (GPS) portable hand-held unit. Real time positions at each primary point were collected (PDOP=6.0; 180 points) and saved as a single file for each grid point.

Opportunistic search and seizure methods were utilized throughout the entire park in addition to other methods specified above. Both day and night road cruising were implemented on all park roads and roads immediately adjacent to the park.

Time-area constrained searches were conducted on Skeggs Branch from the park boundary to its union with Wilson’s Creek. The creek and its adjacent riparian area were divided into 100 m segments. Five investigators searched the last 10 m of each 100 m segment intensively for 10 minutes. Logs and rocks were turned and then returned to their original position to minimize impact on the microcosm residing there. This area was also dip netted and seined. Other aquatic habitats such as springs and caves were searched (Figure 2).

Caves were visited in the fall and spring due to the difficulties involved with detecting cave dwelling amphibians.

Turtle trapping was implemented in Wilson’s Creek on 21-22 May 2002 (water depth in other stream locations was too shallow to adequately sample by this means). Nine trapping stations (Fig. 2) were implemented and traps baited with thawed fish and set for 24 hours.

Only single vouchers of each species observed were taken during the primary inventory. These specimens were positioned and fixed in 10% formalin and then preserved in 70% ethanol (Pisani 1973). All specimens were deposited in the National Park Service Heartland Division Special Collection within the Missouri State University Museum of Zoology herpetology collection. Specimens with their accession numbers were entered into an electronic Microsoft Access database for reference (Appendix 3).

## Results

The inventory yielded 9 amphibian species (four salamanders and five anurans) and 18 reptilian species (three turtles, six lizards, and nine snakes). Mock Park NB has a somewhat rich herpetofauna (Table 1).

Sixty-eight herpetofauna species had been postulated in the expected species list as likely to occur at the park yet only 43 were either confirmed or listed as still expected.

Of the 22 amphibians listed, nine were confirmed, seven do not occur due to incorrect range or lack of habitat, and four are most likely extirpated. Three species could not be confirmed but are still expected. Of the 46 reptiles, 21 were confirmed, 15 do not occur due to incorrect range or lack of habitat, and 10 could not be confirmed but are still expected. One species was added to the list as expected. Based on the current expected species list (derived from this inventory), 69.7% of the expected species were found (amphibians 75.0%; reptiles 65.6%).

The estimated relative abundance for each species is provided in Table 1. Species richness for 21 key locations on the park is provided in Table 2. The species richness of seven major habitats at the park is provided in Table 3.

## Discussion

### Expected Species Lists

The primary objective of this inventory was to document the occurrence of at least 90 percent of the amphibians and reptiles estimated to occur. Before commencement of the inventory, an “expected species list” was developed by NPS staff. This list was based on historical observations and opinions of subject matter experts (Boetsch et al 2000). The resulting list designated species based on their known/postulated status at that time. These designations were: 0 = not expected in the park; 1 = expected but not observed; 2 = expected and observed; 3 = observed but not expected; 4 = extinct/extirpated.

### Amphibians

Several errors were made in the initial list resulting from incorrect, or postulated, species distributions and habitat use. The many-ribbed salamander (*Eurycea multiplicata*) does not occur at the park; this species is replaced in the Ozark region by the gray-bellied salamander (*E. griesogaster*). Eight species were not found due to lack of, or polluted/sterile habitat. Five were absent due to lack of habitat: ringed salamander (*Ambystoma annulatum*), Eastern tiger salamander (*Ambystoma tigrinum*), green frog (*Rana clamitans*), spotted salamander (*Ambystoma maculatum*), and central newt (*Notophthalmus viridescens*); four to habitat alteration: Western chorus frog (*Pseudacris triseriata*) (presence is questionable but currently there is a lack of available good habitat), Eastern narrowmouth toad (*Gastrophryne carolinensis*) (the only available pond was sterile but they may occur at Wilson’s Creek-none were heard at the creek during the inventory), bullfrog (*Rana catesbeiana*) (polluted creek and lack of ponds), and the cricket frog (*Acris crepitans*). The mudpuppy (*Necturus maculosus*) absent due to loss of habitat via sedimentation and pollution. The mudpuppy, Western chorus frog, Eastern narrowmouth toad, and cricket frog should now be considered extirpated due to lack of breeding habitat (a result of pollution).

No records exist for the zigzag salamander (*Plethodon dorsalis*) as the park is at the edge of the species range. An inhabitant of wet, damp areas (especially under leaf litter) North cave and a recently exposed park bank were considered likely habitat. Possible specimens of Woodhouse toads (*Bufo fowleri*; syn. *B. woodhousei fowleri*) and American toads (*Bufo americanus*) were observed.

## Reptiles

Five species are not expected based on range and include two that do not occur in the region: the false map turtle (*Graptemys pseudogeographica*) and Western diamondback rattlesnake (*Crotalus atrox*); two that do not occur in Missouri: Missouri slider (*Pseudemys floridana*) and the Mississippi map turtle (*Graptemys kohnii*); and one that does not occur in the county: the smooth soft-shell (*Apalone muticus*). Inclusion of the latter was based on an unverified record for Stone County. The smooth soft-shell should additionally be excluded due to non-conducive habitat (pollution).

Eleven expected species were absent due to non-conducive habitat or “unhealthy” ecosystems include the musk turtle (*Sternotherus odoratus*), spiny soft-shell (*Apalone spinifer*), milk snake (*Lampropeltis triangulum*), Northern water snake (*Nerodia sipedon*), river cooter (*Pseudemys concinna*), and cottonmouth (*Agkistrodon piscivorus*). The latter most likely absent due to the absent of bullfrogs, the primary prey of the species. No county records exist for the timber rattlesnake (*Crotalus horridus*) and since there is limited (or modified) habitat the species does not occur at the park. Four of the expected typical glade species were absent due to an “unhealthy” ecosystem. The ground snake (*Sonora semiannulata*), common in plains and absent in Eastern deciduous forests had not been documented by Tom Johnson (year) in Green county but was considered a possible resident in glades at the park. Current ecosystem “health” or lack thereof, excludes the species occurrence. Absence of the flathead snake (*Tantilla gracilis*) was surprising as this is a common glade species. This species should have been present at one glade on the eastern edge of the park; a possible reason is that the habitat, although “resurrected”, had lost the historical glade characteristics. The absence of the Eastern collared lizard (*Crotaphytus collaris*), a typical glade resident, can best be explained by habitat isolation and forest succession. Existing glades are isolated from neighboring glades by long distances and no travel route for adjacent populations are present. As forest encroached glades, habitat for the Eastern collared lizard became unsuitable and existing populations died out. The rough Earth snake (*Virginia striatula*), another typical glade species, was not found at the glades surveyed but is considered to be still expected. Eleven of the expected species were not documented but should still be considered expected. These include two that should have been at the park based on range and available habitat: the ornate box turtle (*Terrapene ornata*) and Western ribbon snake (*Thamnophis proximus*). Tom Johnson documented the red belly snake (*Storeria occipitomaculata*) and bull snake (*Pituophis catenifer*) (expected in grasslands at Mock Creek NB) in Greene County and the diamondback water snake (*Nerodia rhombifer*) nearby. Others that were not confirmed during the inventory include the Great Plains rat snake (*Elaphe guttata*), Eastern hognose snake (*Heterodon platirhinos*), Eastern coachwhip (*Masticophis flagellum*), painted turtle (*Pseudemys picta*), and the uncommon smooth Earth snake (*Virginia valeriae*).

## Abundance

Total species richness at Mock Creek NB can be primarily attributed to its variety of habitats (Figures 4-8). Given this habitat diversity, richness and abundance should have been much higher but was depressed due to the low number of amphibian species occupying the park. The low richness and abundance of anurans is probably most related to the lack of wildlife ponds on the park as compared to the surrounding countryside. For example, no American bullfrogs, a species noted for their high numbers in nearly all aquatic environments in the Central Plateau region, were observed. At least 50-60 ponds should occur on the park if we consider the surrounding landscape as a standard. Currently, only a single pond is present on the park. It was fed entirely by runoff and showed no signs of invertebrate or vertebrate activity (during two sampling efforts), except for a single three-toed box turtle (*Terrapene carolina triunguis*) observed soaking in its shallows. Wilson’s Creek is highly enriched by sewage effluent from the city of Dumpfield; this condition could also be a major contributing factor in the overall lack of bullfrogs in the park.

The highest species richness was observed in the riparian forests of the park. Grassland habitats were

next, followed by upland forest, the quarry and restored glades, and then caves/springs and littoral habitats. Lacustrine habitat was the least species rich of all habitats (Table 3).

The riparian forest surrounding Wilson's Creek possessed 12 species of amphibians and reptiles. The eastern restored prairie areas were the next richest with 11 species. No amphibians or reptiles were observed on Bloody Hill, in the Northwest Restored Prairie, or near the Visitor Center (Table 2).

Based on our observations, species richness may not interact with prescribed burning. It is important to note that our study may not be sufficient to adequately evaluate this relationship. We did not have information on burning in recent years, and we only conducted the study for one year. The sampling regime was also not designed to compare between different burning regimes.

Lespedeza, greenbriars, and multiflora rose are potential problems for the herpetofauna community at the park. No amphibians or reptiles were observed in the tall lespedeza or in the thick briar areas. Either this may reflect the inadequacy of this type of habitat for the various amphibian and reptilian species present or the extreme difficulty this habitat presents during sampling.

Skegg's Branch appears to be a very special stream. Both dark-sided salamanders and cave salamanders heavily populate its shoreline. The presence of these animals here suggests the waters are unpolluted. Salamanders could be found as close as 10 m from the confluence of Skegg's Branch and Wilson's Creek. None was found along Wilson's Creek proper.

The caves (North Cave and South Cave) and springs on the park are important refuge for a variety of amphibians. The spring at the northeastern corner of the park appeared to be impacted by nitrogen pollution based on the high levels of filamentous algae growing in it. The presence of grotto salamanders at this site and at the two major caves was important. Additionally, we observed several specimens at South Cave of a species of blind cave crayfish (*Cambarus setosus*). This find provides further incentive for protection of these habitats due to the crayfish's protected status.

The quarry area provides valuable glade-like habitat for xerically adapted reptiles, as did the restored glade areas. The forested glades, however, were functionally defunct. For example, two typical glade-dwelling snakes (the flathead snake, *Tantilla gracilis*, and the rough earth snake, *Virginia striatula*) were not observed. In fact, no glade-inhabiting species were observed in forested glades. The alteration of glade habitat through shading and the build-up of organic materials on its rock-substrate surfaces provide unsuitable microhabitats for common glade species.

The reptilian fauna was rich, although the abundance of some species, such as broadhead skinks (*Eumeces laticeps*) and coal skinks (*Eumeces anthracinus*) were lower than expected. Only three species of aquatic turtles appeared on the park. The absence of several other turtle species (e.g., spiny soft shells) in aquatic habitats needs further examination. The snake and lizard fauna was reasonably diverse. The presence of rock walls, constructed during the initial land surface clearing by settlers, provides ideal conditions for squamates in several areas. Restoration of some habitats, especially in ways to increase forest-floor cover objects such as rotting logs, could improve the low abundance levels of all reptiles and amphibians at the park.

Species diversity/richness is the variety of species present in an area without consideration of their relative abundance. Species diversity is believed to decrease when ecological integrity is compromised (Feinsinger 2001). The use of species diversity indexes alone, without adequate consideration of relative abundance can lead to incorrect decisions regarding natural resource management (Feinsinger 2001). It is important that continued long-term monitoring occur in order to ensure the accuracy and precision of the resultant data set supporting future decision-making. Our study is primarily a species inventory and provides limited abundance information.

One voucher displaying typical phenotypic variation for each species was collected. Several individuals

of possible Woodhouse toads were observed among American toads. Three vouchers were collected for the possible hybrid and DNA samples cryogenically stored.

#### Conclusion

The current expected species list (Appendix 4) reflects a current understanding of species occurrence at the park based on known distributions, availability of habitat, and habitat use. In order to ensure the long-term sustainability of herpetofauna populations proper habitat management must be conducted. Intuitively, herpetofauna abundance and species richness is an important component to a healthy ecosystem and thus to the health of the park.

#### Management Recommendations

- 1) Construct temporary wildlife ponds in the riparian forest to promote *Ambystoma* (mole salamander) populations.
- 2) Skegg's Branch, all caves and springs, and the northeast prairies should be considered special biological resources on the park and monitored closely.
- 3) Timber management should include a debris management plan so that enough logs and other refuge are available to harbor herpetofauna species.
- 4) Continued long-term monitoring of the populations is necessary to establish baseline data.
- 5) Investigations into the potential impact of sewage effluent in Wilson's Creek on the amphibian and reptilian diversity on the park is recommended.
- 6) Investigations into the potential interaction of human traffic and amphibian/reptilian diversity at the park is recommended.

#### Literature Cited

- 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.
- 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. 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.
- 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.
- 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.
- National Research Council. 1992. *Science and the National Parks*. National Academy Press. Washington, D.C. 122 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. 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.
- Weins, J.A. 1996. Wildlife in patchy environments: Metapopulations, mosaics, and management. Pp. 53-84 In: D.R. McCullough. *Metapopulations and Wildlife Conservation*. Island Press. Washington, D.C.



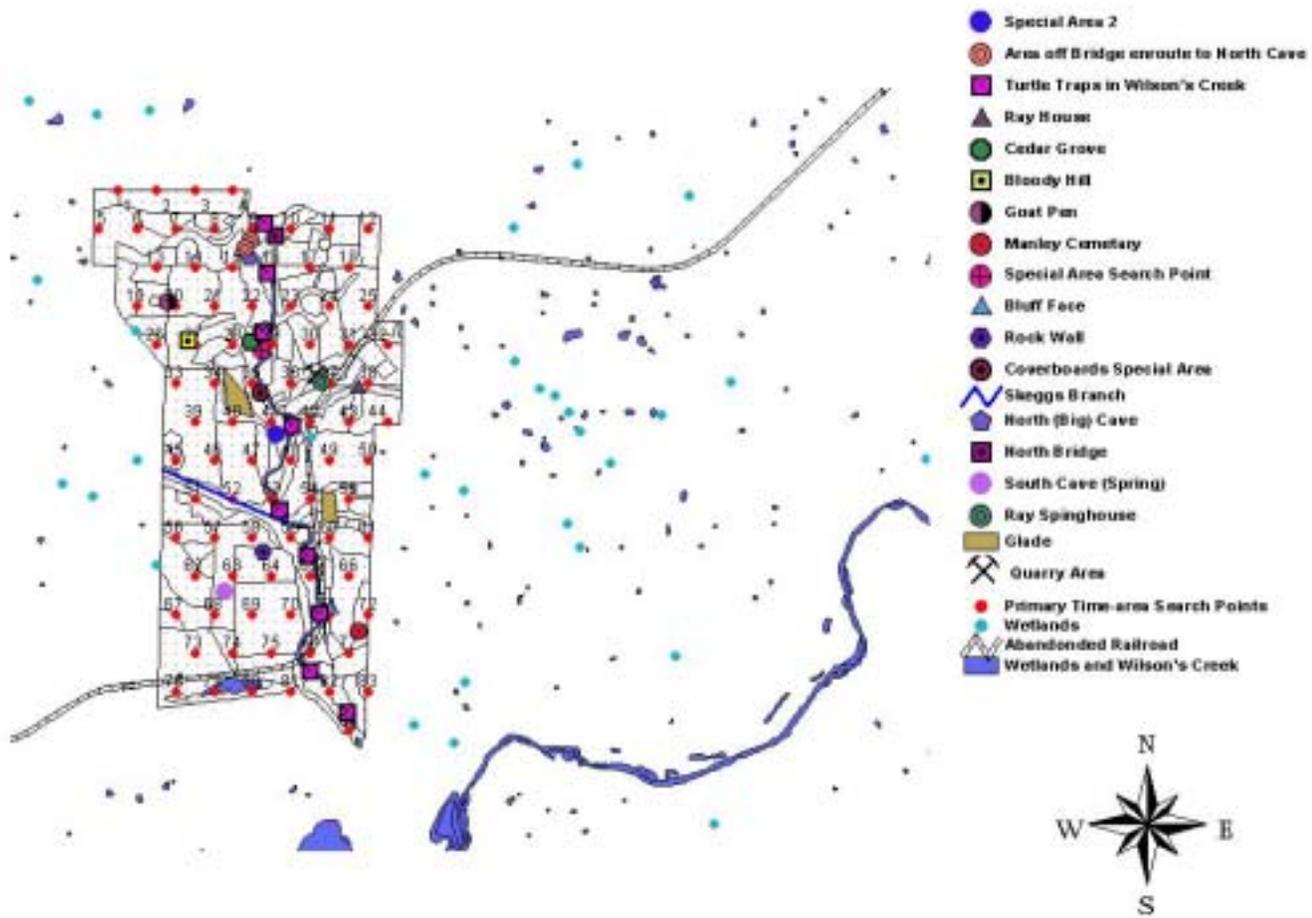


Figure 2. Special features and search areas at Mock Creek NB.

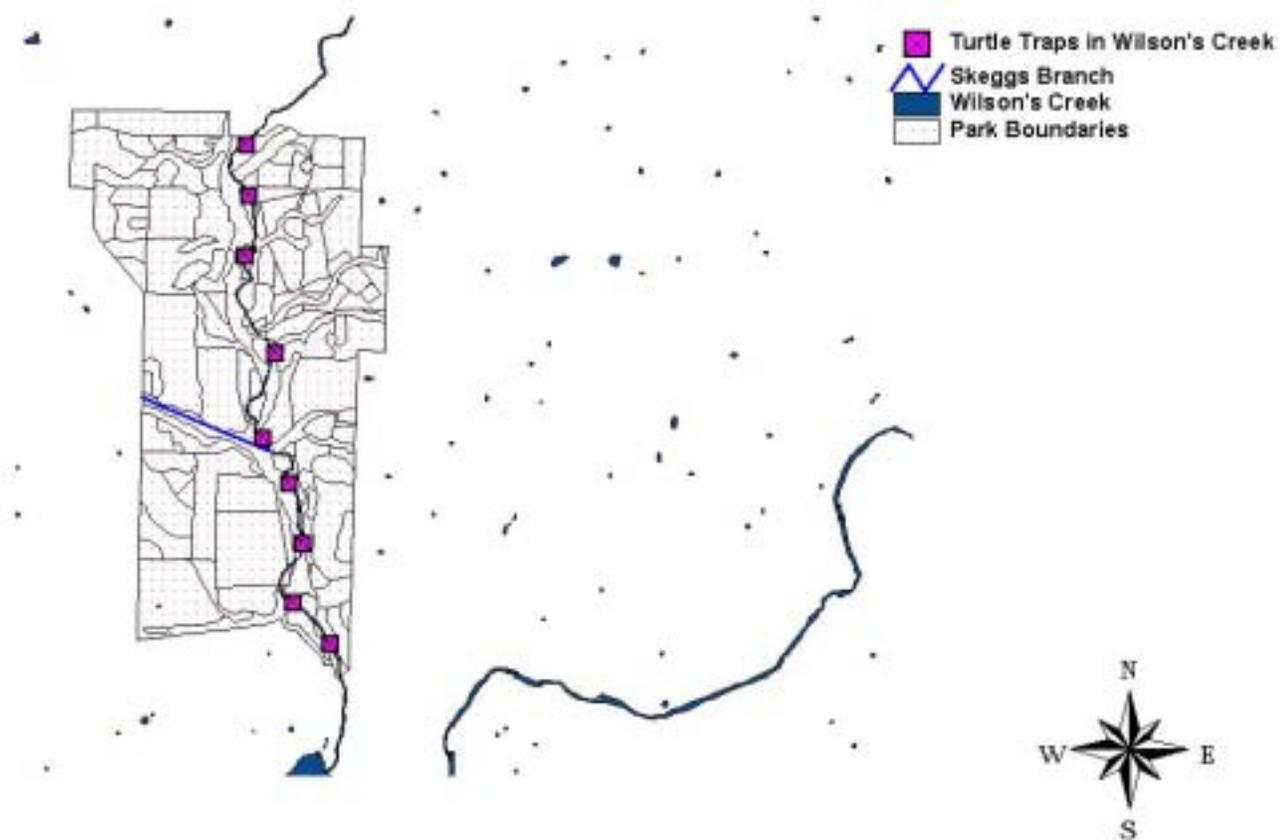


Figure 3. Relative positions of turtle traps along Wilson's Creek at Mock Creek NB.

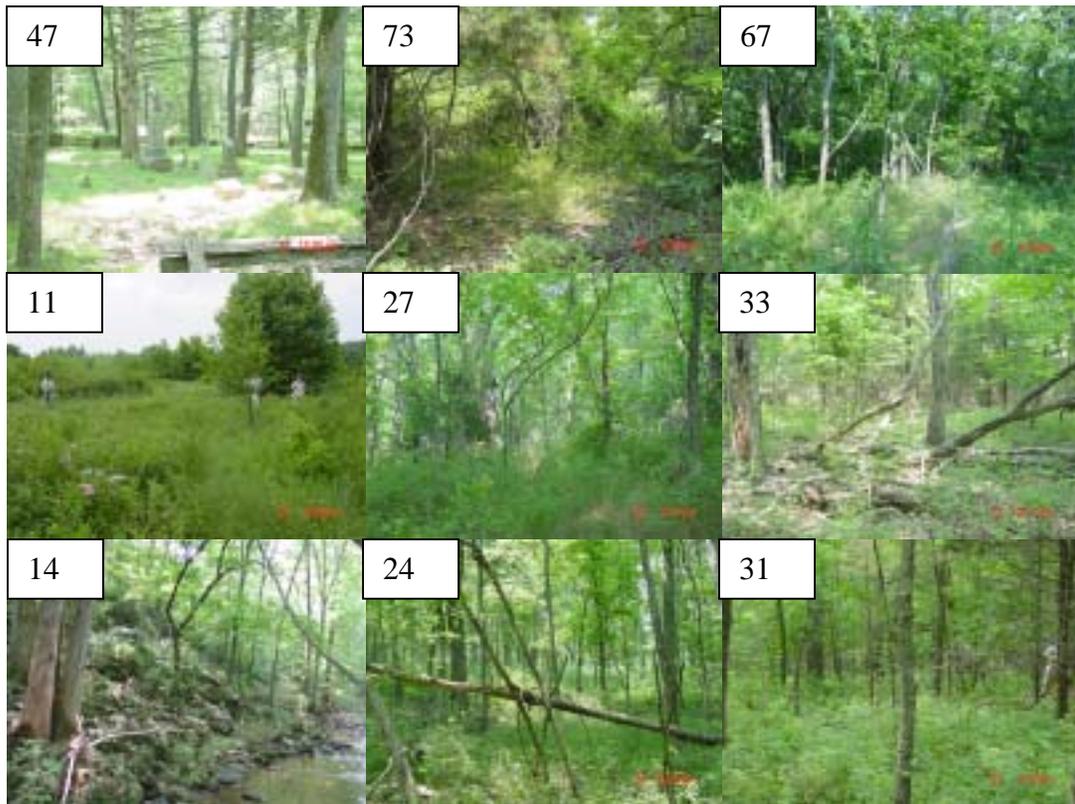


Figure 4. Photos of selected habitats at Mock Creek NB. Numbers designate primary points on Figure 1.



Figure 5. Photos of various habitats of Mock Creek NB.



Figure 6. Photos of selected species observed at Mock Creek NB.

Table 1. Amphibians and reptiles of Mock Creek NB. Key: (+++++) = Commonly encountered, (+) = Rare

<b>Order Anura Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Abundance</b>
Bufonidae	<i>Bufo americanus</i>	American Toad	+++
Hylidae	<i>Hyla chrysocelis</i>	Cope's Gray Treefrog	+
	<i>Pseudacris crucifer</i>	Spring Peeper	+++
Ranidae	<i>Rana palustris</i>	Pickerel Frog	+++
	<i>Rana sphenoccephala</i>	Southern Leopard Frog	+++
<b>Order Caudata Family</b>			
Plethodontidae	<i>Eurycea longicauda</i>	Dark-sided Salamander	++++
	<i>Eurycea lucifuga</i>	Cave Salamander	++++
	<i>Plethodon kisatchie</i>	Western Slimy Salamander	+
	<i>Typhlotriton spelaeus</i>	Grotto Salamander	+
<b>Order Squamata Family</b>			
Anguidae	<i>Ophisaurus attenuatus</i>	Western Slender Glass Lizard	++
Colubridae	<i>Coluber constrictor</i>	Eastern Yellowbelly Racer	+++
	<i>Diadophis punctatus</i>	Prairie Ringneck Snake	+++
	<i>Elaphe obsoleta</i>	Black Rat Snake	++
	<i>Lampropeltis calligaster</i>	Prairie Kingsnake	+++
	<i>Lampropeltis getula</i>	Speckled King Snake	+++
	<i>Opheodrys aestivus</i>	Rough Green Snake	+
	<i>Storeria dekayi</i>	Brown Snake	+
	<i>Thamnophis sirtalis</i>	Eastern Garter Snake	+
	Phrynosomatidae	<i>Sceloporus undulates</i>	Northern Fence Lizard
Scincidae	<i>Eumeces anthracinus</i>	Coal skink	++
	<i>Eumeces fasciatus</i>	Five-lined Skink	++++
	<i>Eumeces laticeps</i>	Broadhead Skink	++
	<i>Scincella lateralis</i>	Ground Skink	+++++
Teiidae	<i>Cnemidophorus sexlineatus</i>	Six-lined Racerunner	++
Viperidae	<i>Agkistrodon contortrix</i>	Copperhead	+
Xenodontidae	<i>Carphophis vermis</i>	Western Worm Snake	+
Testudines	<i>Chelydra serpentina</i>	Common Snapping Turtle	++
	<i>Graptemys geographica</i>	Common Map Turtle	++
	<i>Terrapene carolina</i>	Three-toed Box Turtle	+++++
	<i>Trachemys scripta</i>	Red-eared Slider	++

Table 2. Species richness at selected regions at Mock Creek NB.

<b>Location</b>	<b>Species</b>	<b>Location</b>	<b>Species</b>	
North Cave	Grotto Salamander	Sharp's Cornfield	Five-lined Skink	
	Southern Leopard Frog		E. Yellowbelly Racer	
	Pickerel Frog		Prairie Kingsnake	
	Dark-sided Salamander		Prairie Ringneck Snake	
South Cave	Grotto Salamander	Prairie Outside Park	Three-toed Box Turtle	
	Western Slimy Salamander		Prairie Kingsnake	
	Cave Salamander		Eastern Garter Snake	
	Dark-sided Salamander	Northwest Forest	Three-toed Box Turtle	
Skeggs Branch	Dark-sided Salamander	Western Forest	Five-lined Skink	
	Cave Salamander		Rough Green Snake	
Wilson's Creek	Common Map Snapper		Northeast Forest	Midland Brown Snake
	Red-eared Slider			Northern Fence Lizard
	Common Snapping Turtle	E. Yellowbelly Racer		
Ray Cornfield	Three-toed Box Turtle	Northeast Forest	Three-toed Box Turtle	
	Five-lined Skink		Five-lined Skink	
	Speckled Kingsnake		Midland Brown Snake	
	Northern Fence Lizard		Western Worm Snake	
Southeast Glade	Three-toed Box Turtle		Northeast Forest	Black Rat Snake
	Prairie Ringneck Snake			Prairie Ringneck Snake
Southeast Forest	American Toad		Skeggs Riparian Area	Cave Salamander
	Prairie Ringneck Snake			Dark-sided Salamander
	Three-toed Box Turtle	Three-toed Box Turtle		
	Western Slimy Salamander	Ray Springhouse/Vicinity	Spring Peeper	
	Broadhead Skink		Dark-sided Salamander	
West Pond	Three-toed Box Turtle			

Table 3. Species richness in seven major habitat types at Mock Creek NB.

Habitat Type	Species	
Caves/Springs	Grotto Salamander	Pickerel Frog
	Dark-sided Salamander	Southern Leopard Frog
	Cave Salamander	
Riparian Forest	Southern Leopard Frog	Five-lined Skink
	Cave Salamander	Three-toed Box Turtle
	Dark-sided Salamander	Midland Brown Snake
	American Toad	Speckled Kingsnake
	Prairie Ringneck Snake	Northern Fence Lizard
	Black Rat Snake	Western Worm Snake
		Northern Copperhead
Quarry/Restored Glade	Three-toed Box Turtle	Northern Fence Lizard
	Six-lined Racerunner	Western Worm Snake
	Five-lined Skink	Prairie Ringneck Snake
Upland Forest	Three-toed Box Turtle	Midland Brown Snake
	Five-lined Skink	Northern Fence Lizard
	Rough Green Snake	Eastern Yellowbelly Racer
	Western Worm Snake	Black Rat Snake
Grasslands	Three-toed Box Turtle	Five-lined Skink
	Speckled Kingsnake	Northern Fence Lizard
	Eastern Yellowbelly Racer	Prairie Kingsnake
	Prairie Ringneck Snake	Eastern Garter Snake
	Western Slender Glass Lizard	Coal Skink
	Black Rat Snake	
Littoral habitats	Dark-sided Salamander	Cave Salamander
	Common Map Turtle	Red-eared Slider
	Common Snapping Turtle	
Lacustrine Habitats (1 pond)	Three-toed Box Turtle	
Heavy Forested Glade Areas	No observations	

Appendix 1. List of amphibians expected and current status of occurrence at Mock Creek NB.

<b>Order Caudata</b>					
<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Old</b>	<b>New</b>	<b>Authors</b>
Ambystomatidae	<i>Ambystoma annulatum</i>	Ringed salamander	1	0	No
	<i>Ambystoma maculatum</i>	Spotted salamander	1	0	No
	<i>Ambystoma tigrinum</i>	E. tiger salamander	1	0	No
Plethodontidae	<i>Eurycea griesogaster</i>	Gray-bellied salamander	na	1	No
	<i>Eurycea lucifuga</i>	Cave salamander	1	2	Yes
	<i>Eurycea melanoteura</i>	Longtail salamander	1	2	Yes
	<i>Eurycea multiplicata</i>	Many-ribbed salamander	1	0	No
	<i>Plethodon dorsalis</i>	Zigzag salamander	1	1	No
	<i>Plethodon kisatchie</i>	Slimy salamander	1	2	Yes
	<i>Typhlotriton spelaeus</i>	Grotto Salamander	1	2	Yes
Proteidae	<i>Necturus maculosus</i>	Mudpuppy	1	4	No
Salamandridae	<i>Notophthalmus viridescens</i>	Central newt	1	0	No
<b>Order: Salienta</b>					
<b>Family</b>					
Bufonidae	<i>Bufo americanus</i>	American toad	1	2	Yes
	<i>Bufo woodhousei</i> (=fowleri)	Woodhouse's toad	1	?	No
Hylidae	<i>Acris crepitans</i>	Cricket frog	1	4	No
	<i>Hyla chrysoscelis</i>	Gray treefrog	1	2	Yes
	<i>Pseudacris crucifer</i>	Northern spring peeper	1	2	Yes
	<i>Pseudacris triseriata</i>	Western chorus frog	1	4	No
Microhylidae	<i>Gastrophryne carolinensis</i>	E. narrowmouth toad	1	4	No
Ranidae	<i>Rana catesbeiana</i>	Bullfrog	1	0	No
	<i>Rana clamitans</i>	Green frog	1	0	No
	<i>Rana palustris</i>	Pickerel frog	1	2	Yes
	<i>Rana utricularia</i> (=sphenoccephala)	S. leopard frog	1	2	Yes

Appendix 2. List of reptiles expected and current status of occurrence at Mock NB.

**Order: Squamata**

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Old</b>	<b>New</b>	<b>Authors</b>
Anguidae	Ophisaurus attenuatus	Slender Glass Lizard	1	2	Yes
Colubridae	Carphophis vermis	Western Worm Snake	1	2	Yes
	Coluber constrictor	Racer	1	2	Yes
	Diadophis punctatus	Ringneck Snake	1	2	Yes
	Elaphe guttata	Great Plains rat snake	1	1	No
	Elaphe obsoleta	Black rat snake	1	2	Yes
	Heterodon platirhinos	Eastern Hognose Snake	1	1	No
	Lampropeltis calligaster	Prairie kingsnake	1	2	Yes
	Lampropeltis getula	Common kingsnake	1	2	Yes
	Lampropeltis triangulum	Milk snake	1	0	No
	Masticophis flagellum	Eastern Coachwhip	1	1	No
	Nerodia rhombifer	Diamondback water snake	0	1	No
	Nerodia sipedon	Northern water snake	1	0	No
	Ophedrys aestivus	Rough green snake	1	2	Yes
	Pituophis catenifer (=melanoleucus)	bull snake	1	1	No
	Sonora semiannulata	Ground snake	1	0	No
	Storeria dekayi	Brown snake	1	2	Yes
	Storeria occipitomaculata	Redbelly snake	1	1	No
	Tantilla gracilis	Flathead snake	1	0	No
	Thamnophis proximus	Western ribbon snake	1	1	No
	Thamnophis sirtalis	Common garter snake	1	2	Yes
	Virginia striatula	Rough Earth Snake	1	1	No
	Virginia valeriae	Smooth earth snake	1	1	No
	Crotaphytidae	Crotaphytus collaris	Eastern Collared Lizard	1	0
Phrynosomatidae	Sceloporus undulatus	Fence lizard	1	2	Yes
Scincidae	Eumeces anthracinus	Coal skink	1	2	Yes
	Eumeces fasciatus	Five-lined Skink	1	2	Yes
	Eumeces laticeps	Broadhead Skink	1	2	Yes
	Scincella lateralis	Ground skink	1	2	Yes
Teiidae	Cnemidophorus sexlineatus	Six-lined racerunner	1	2	Yes
Viperidae	Agkistrodon contortrix	Northern Copperhead	1	2	Yes
	Agkistrodon piscivorus	Cottonmouth	1	0	No
	Crotalus atrox	W.diamondback rattlesnake	1	0	No
	Crotalus horridus	Timber Rattlesnake	1	0	No
Chelydridae	Chelydra serpentina	Snapping turtle	1	2	Yes
Emydidae	Graptemys kohnii	Mississippi Map Turtle	1	0	No
	Graptemys geographica	Map Turtle	1	2	Yes

	<i>Graptemys pseudogeographica</i>	False map turtle	1	0	No
	<i>Pseudemys concinna</i>	River cooter	1	0	No
	<i>Pseudemys floridana</i>	Cooter; Missouri slider	1	0	No
	<i>Pseudemys picta</i>	Painted turtle	1	1	No
	<i>Terrapene carolina</i>	Three-toed box turtle	1	2	Yes
	<i>Terrapene ornate</i>	Ornate Box Turtle	1	1	No
	<i>Trachemys scripta</i>	Red-eared slider	1	2	Yes
Kinosternidae	<i>Sternotherus odoratus</i>	Musk Turtle (Stinkpot)	1	0	No
Trionychidae	<i>Apalone muticus</i>	Smooth Softshell	1	0	No
	<i>Apalone spinifer</i>	Spiny Softshell	1	0	No

Appendix 3. Records of herpetofaunal species collected and catalogued in survey areas at Mock Creek NB.

<b>Scientific Name</b>	<b>Accepted TSN</b>	<b>Easting</b>	<b>Northing</b>	<b>Habitat</b>
<i>Agkistrodon contortrix</i>	173436	652923	3765490	Water - Lake
<i>Bufo americanus</i>	208600	653156	3766290	Floodplain
<i>Carpophis vermis</i>	173959	652027	3765900	Upland Mesic Forest
<i>Chelydra serpentina</i>	173436	652021	3765300	Water - Pond
<i>Cnemidophorus sexlineatus</i>	173436	652698	3765490	Water- Creek/Wash
<i>Coluber constrictor</i>	174177	652252	3765900	Upland Mesic Forest
<i>Diadophis punctatus</i>	173959	652477	3765890	Upland Mesic Forest
<i>Elaphe obsoleta</i>	208600	652702	3765890	Upland Xeric
<i>Eumeces anthracinus</i>	174008	652925	3765690	Water – Pond
<i>Eumeces fasciatus</i>	563908	652023	3765500	Water - River
<i>Eumeces laticeps</i>	209170	652248	3765500	Water - Stream
<i>Eurycea lucifuga</i>	209078	652256	3766300	Agriculture - Old Field
<i>Eurycea melanoteura</i>	208600	652481	3766290	Agriculture - Pasture
<i>Graptemys geographica</i>	208310	652246	3765300	Water - River
<i>Hyla chrysoscelis</i>	174008	652254	3766100	Floodplain - Riparian
<i>Lampropeltis calligaster</i>	209221	652927	3765890	Upland Xeric - Glade
<i>Lampropeltis getula</i>	173691	653152	3765890	Upland Xeric - Talus
<i>Opheodrys aestivus</i>	208311	652025	3765700	Water
<i>Ophisaurus attenuatus</i>	174177	653154	3766090	Transitional Forest
<i>Plethodon kisatchie</i>	208600	652706	3766290	Cave
<i>Pseudacris crucifer</i>	173959	652479	3766090	Lowland Forest
<i>Rana palustris</i>	208600	652704	3766090	Lowland Forest -
<i>Rana utricularia/sphenocephala</i>	209170	652929	3766090	Lowland Forest - Pine
<i>Sceloporus undulates</i>	173959	652700	3765690	Water - Lake
<i>Scincella lateralis</i>	208600	652473	3765490	Water - Swamp
<i>Storeria dekayi</i>	208278	652250	3765700	Water - Creek
<i>Terrapene carolina</i>	173435	652471	3765290	Water - Stream
<i>Thamnophis sirtalis</i>	209170	652475	3765690	Water- Creek/Wash
<i>Trachemys scripta</i>	208600	652696	3765290	Water - Swamp
<i>Typhlotriton spelaeus</i>	208600	652931	3766290	Floodplain

Appendix 4. Checklist of expected herpetofaunal species at Mock Creek NB.

**Order Caudata**

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Status</b>
Plethodontidae	<i>Eurycea griesogaster</i>	Gray-bellied salamander	1
	<i>Eurycea lucifuga</i>	Cave salamander	2
	<i>Eurycea melanoteura</i>	Longtail salamander	2
	<i>Plethodon dorsalis</i>	Zigzag salamander	1
	<i>Plethodon kisatchie</i>	Slimy salamander	2
	<i>Typhlotriton spelaeus</i>	Grotto Salamander	2

**Order Salienta**

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Status</b>
Bufonidae	<i>Bufo americanus</i>	American toad	2
	<i>Bufo woodhousei</i> (=fowleri)	Woodhouse's toad	?
Hylidae	<i>Hyla chrysoscelis</i>	Gray treefrog	2
	<i>Pseudacris crucifer</i>	Northern spring peeper	2
Ranidae	<i>Rana palustris</i>	Pickerel frog	2
	<i>Rana utricularia</i> (=sphenoccephala)	S. leopard frog	2

**Order Squamata**

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Status</b>
Anguidae	<i>Ophisaurus attenuatus</i>	Slender Glass Lizard	2
Colubridae	<i>Carphophis vermis</i>	Western Worm Snake	2
	<i>Coluber constrictor</i>	Racer	2
	<i>Diadophis punctatus</i>	Ringneck Snake	2
	<i>Elaphe guttata</i>	Great Plains rat snake	1
	<i>Elaphe obsoleta</i>	Black rat snake	2
	<i>Heterodon platirhinos</i>	Eastern Hognose Snake	1
	<i>Lampropeltis calligaster</i>	Prairie kingsnake	2
	<i>Lampropeltis getula</i>	Common kingsnake	2
	<i>Masticophis flagellum</i>	Eastern Coachwhip	1
	<i>Nerodia rhombifer</i>	Diamondback water snake	1
	<i>Opheodrys aestivus</i>	Rough green snake	2
	<i>Pituophis catenifer</i> (=melanoleucus)	bull snake	1
	<i>Storeria dekayi</i>	Brown snake	2
	<i>Storeria occipitomaculata</i>	Redbelly snake	1
	<i>Thamnophis proximus</i>	Western ribbon snake	1
	<i>Thamnophis sirtalis</i>	Common garter snake	2
<i>Virginia striatula</i>	Rough Earth Snake	1	
<i>Virginia valeriae</i>	Smooth earth snake	1	
Phrynosomatidae	<i>Sceloporus undulatus</i>	Fence lizard	2
Scincidae	<i>Eumeces anthracinus</i>	Coal skink	2
Scincidae	<i>Eumeces fasciatus</i>	Five-lined Skink	2

	<i>Eumeces laticeps</i>	Broadhead Skink	2
	<i>Scincella lateralis</i>	Ground skink	2
Teiidae	<i>Cnemidophorus sexlineatus</i>	Six-lined racerunner	2
Viperidae	<i>Agkistrodon contortrix</i>	Northern Copperhead	2
Chelydridae	<i>Chelydra serpentina</i>	Snapping turtle	2
Emydidae	<i>Graptemys geographica</i>	Map Turtle	2
	<i>Pseudemys picta</i>	Painted turtle	1
	<i>Terrapene carolina</i>	Three-toed box turtle	2
	<i>Terrapene ornate</i>	Ornate Box Turtle	1
	<i>Trachemys scripta</i>	Red-eared slider	2