

# **A Herpetofaunal Inventory of Wilson's Creek National Battlefield**

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September 3, 2003

Technical Report NPS/HTLN/P6370010459

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Inventory and Monitoring Program  
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Republic, MO 65738

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## Summary

No information on current species composition, distribution, and abundance existed for the Wilson's Creek NB 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, and road cruising. Aquatic methods included dip netting, seining, and the use of turtle traps. An expected species list incorrectly listed 11 amphibians and 16 reptiles due to incorrect species range and/or habitat requirements. Upon revising this list, the inventory yielded 82% of the amphibians (9 of 11) and 67% of the reptiles (20 of 30). Wilson's Creek NB has a somewhat rich herpetofauna but certain species are absent; an absence attributed to lack of, or marginal, habitat. All species were native and no sensitive herpetofauna were encountered. 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 Wilson's Creek NB.

## Acknowledgments

The authors wish to thank the staff at Wilson's Creek NB 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.

Stemming from this challenge and a widespread concern regarding the status of herpetofaunal populations at Wilson's Creek NB, an inventory was deemed necessary to determine resident amphibians and reptiles. No previous inventories of the herpetofauna at Wilson's Creek NB had been conducted and there was no data documenting species composition, distribution, and abundance.

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 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 to be major contributors to biodiversity declines (Stebbins and Cohen 1995).

Although the habitats at the Wilson's Creek NB are not virgin lands, their setting on the Ozark Plateau renders the park an important conservation area. Two threats to the park are water pollution and invasive exotic plants: Wilson's Creek is the largest stream at the park and receives large volumes of sewage effluent (currently the creek 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. Their management to limit disturbance may allow Wilson's Creek NB to act as an ecological source for refueling adjacent populations (Wiens 1996). Despite this importance as a biodiversity holding, little is known about Wilson's Creek NB wildlife and plant communities.

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 Wilson's Creek NB (Tables 5& 6) 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

Wilson's Creek NB is located south of Springfield, MO, on the boundary between Greene and Christian Counties in the southwestern corner of the state (Figure 1). The park encompasses 708 ha (1750 ac), which includes approximately 75% of the historic battlegrounds. The park lies within a karst area along Wilson's Creek upstream from its confluence with the James River and is within the upper portion of the James River Watershed. The watershed terminates at Table Rock Lake near Branson, Missouri, and is an economically important resource to the region. The park is downstream from the city of Springfield, Missouri (population 140,494) which discharges 42.5 million gallons of treated sewage effluent each day. During low flow periods an estimated 80% of the water flowing through Wilson's Creek NB is treated sewage effluent and as such aquatic biota are monitored annually providing an indication of overall stream quality. Approximately 445 ha (1,100 ac) of disturbed land are being restored to oak savanna or historic fields whereas approximately 202 ha (500 ac) are infested with exotic plant species. The park uses prescribed fire on approximately 121.5 ha (300 ac) annually to mimic the natural fire regime that created much of the historical savanna landscape. Development in the surrounding areas of Springfield, Republic, and Battlefield, have dwindled available wildlife habitat thus making the park a "haven" for various wildlife. The primary issue affecting the park is the drastic population growth associated with development of the surrounding region resulting with an increase in development projects that have potential to impact park resources.

## Materials and Methods

The inventory began during the summer 2001 and extended into the summer of 2002 (16-17 July 2001, 12-13 October 2001, 9-10 March 2002, 26-28 April 2002, 21-22 May 2002, and 22-23 June 2002). Inventories were conducted by 5-7 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) 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 Wilson's Creek NB (Figure 2). At each primary point, four secondary points were identified in each primary cardinal compass direction. Coverboard 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).

Forty of the 84 primary points were designated as cover board plots and were visited at least once. Two primary points were not surveyed (one falling in Wilson's Creek, the other inside the Visitor Center). One secondary point was not used at primary points 5, 28, and 34 and two secondary points were not used for primary points 65 and 71.

If a primary grid point appeared in a heavily wooded area, cover boards were not used, and points were designated for time-area constrained searches (TACS). The TACS technique, used at 37 primary points, 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.

Four primary points used both TACS and coverboards. Time-area constrained searches were conducted on Skeggs Branch (Figs. 2, 21, and 25) 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 (Figs. 2 and 21–25) were searched, but time was not limited because of the small size of these habitats at the park.

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 was utilized throughout the entire park in addition to the other two methods. Both day and night road cruising were implemented on all park roads and on roads immediately adjacent to the park. Animals were recorded as encountered.

Caves were visited in both the fall and the spring because of the difficulties involved with detecting cave dwelling amphibians. Their detection activity is highly dependent on water flow that was at a minimal due to drought conditions.

Turtle trapping was implemented in Wilson's Creek on 21-22 May 2002. The water depth in other stream locations was too shallow to adequately sample by this means. Nine trapping stations (Figure 3) were implemented on the creek. Traps were baited with thawed fish and set for 24 hours.

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

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

An expected species list incorrectly listed 11 amphibians and 16 reptiles due to incorrect species range and/or habitat requirements. Upon revising this list, the inventory yielded 82% of the amphibians (9 of 11) and 63% of the reptiles (19 of 30) (Tables 4-6). Four amphibians, originally listed as expected, are considered extirpated.

### Species Richness and Abundance

Wilson's Creek NB has a somewhat rich herpetofauna (Table 1). The inventory yielded nine amphibian species (four salamanders and five anurans) and 20 reptilian species (four turtles, six lizards, and ten snakes). Selected photographs of amphibians and reptiles found at Wilson's Creek NB are in Figure 24. The estimated relative abundance for each species is provided in Table 1. Species distributions are provided in Figures 4–9. Species richness for 21 key locations on the park is provided in Table 2. The species richness of eight primary habitats at the park is provided in Table 3. No obvious associations between prescribed burning and amphibian and reptile distributions were evident (Figures 10–16). Relief changes at the park did not appear to affect overall species richness, although individual species differences may be present (Figures 17–20).

## Discussion

### Expected Species

One amphibian species was incorrectly listed as possible based on range. The many-ribbed salamander (*Eurycea multiplicata*) does not occur at the park; this species is replaced in the Ozark region by the graybelly salamander (*E. multiplicata griseogaster*).

Eight amphibians were not found at the park 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 were absent due to habitat alteration: western chorus frog (*Pseudacris triseriata*), presence at the park is questionable due to 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*), not found due to a polluted creek and lack of ponds; and the cricket frog (*Acris crepitans*). One species, the mudpuppy (*Necturus maculosus louisianensis*), was 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 resulting from pollution.

No records exist for the zigzag salamander (*Plethodon angusticlavius*) 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 hybrids between Woodhouse's toads (*Bufo woodhousii fowleri*; syn. *B. fowleri*) and American toads (*Bufo americanus charlesmithi*) were observed.

Five reptilian species incorrectly listed as expected based on range 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 softshell (*Apalone mutica*). Inclusion of the latter was based on an unverified record for Stone County. The smooth softshell should additionally be excluded due to non-conductive habitat (pollution).

Eleven expected reptiles were absent due to non-conductive habitat or "unhealthy" ecosystems include the musk turtle (*Sternotherus odoratus*), spiny softshell (*Apalone spinifera*), 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 absence of bullfrogs, a 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 (2000) in Greene 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 routes 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 reptiles were not documented (but are still expected) by Dr. Trauth and include two that should have been at the park based on range and available habitat: the ornate box turtle (*Terrapene ornata ornata*) and western ribbon snake (*Thamnophis proximus proximus*). Tom Johnson documented the redbelly snake (*Storeria occipitomaculata occipitomaculata*) and bull snake (*Pituophis catenifer sayi*; syn. *P. melanoleucus sayi*) (expected in grasslands) in Greene County and the diamondback watersnake (*Nerodia rhombifer rhombifer*) nearby. Others include the Great Plains rat snake (*Elaphe guttata emoryi*), eastern hognose snake (*Heterodon platirhinos*), eastern coachwhip (*Masticophis flagellum*), painted turtle (*Chrysemys picta bellii*), and the uncommon smooth earth snake (*Virginia valeriae*).

### Species Richness and Abundance

Total species richness at Wilson’s Creek NB can be primarily attributed to its variety of habitats. Given this habitat diversity, richness and abundance should have been much higher but was depressed due to the low number of amphibian species present. 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 (Figure 26). For example, no American bullfrogs (*Rana catesbeiana*), a species noted for their high numbers in nearly all aquatic environments in the Ozark Plateau region, were observed at Wilson’s Creek NB. 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 at the park (fed entirely by runoff) and it 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 Springfield; 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 at Wilson’s Creek NB (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 Southwest 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 (*Smilax* spp.), and multiflora rose are potential problems for the herpetofaunal community at the park. No amphibians or reptiles were observed in the tall lespedeza or in the thick briar areas. This may reflect either 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 as both dark-sided salamanders and cave salamanders heavily populate its shoreline suggesting the waters are fairly unpolluted. Salamanders could be found as close as 10 m from the confluence of Skegg's Branch and the polluted Wilson's Creek. None were found along Wilson's Creek proper.

The caves (North Cave and South Cave) and springs are important refuges for a variety of amphibians. We observed several specimens of the Missouri special concern blind cave crayfish (*Cambarus setosus*) at South Cave and grotto salamanders at both caves. The spring at the northeastern corner of the park is also important habitat for the grotto salamander; however it appeared to be impacted by nitrogen pollution based on the high levels of filamentous algae present. The presence of these species should provide further incentive for protection of these habitats.

The quarry area provides valuable glade-like habitat for xeric-adapted reptiles, as do 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 at Wilson's Creek NB. In fact, no glade-inhabiting species were observed in forested glades as the alteration of glade habitat through shading and the build-up of organic materials on its rock-substrate surfaces provides unsuitable microhabitats for common glade species.

The reptilian fauna was fairly rich, although the abundance of some species, such as broadhead skinks (*Eumeces laticeps*) and coal skinks (*Eumeces anthracinus pluvialis*) was lower than expected. The broadhead skink requires more of a mature oak-hickory forest (one with a spattering of dead trees and stumps). This species is often associated with tall stumps. This type of forest is generally lacking at Wilson's Creek NB. With respect to the coal skink (a species normally uncommon anyway), this species can often be found along creeks or at the forest/disturbed area/cedar glade interface. The one found during this inventory was in a disturbed area. The loose rocks along the creeks at the park were covered with mosses and lichens, indicating a condition too mesic for this species.

Only three species of aquatic turtles appeared on the park and the absence of several other turtle species (e.g., spiny softshells, *Apalone spinifera*) in aquatic habitats needs further examination. This absence is associated with the pollution of Wilson's Creek and/or absence of habitat.

The snake and lizard fauna was reasonably diverse due to the presence of rock walls (constructed during the initial land surface clearing by settlers) that provide ideal conditions for squamates in several areas of the park. Restoration of some habitats especially in ways to increase forest-floor cover objects such as rotting logs, could improve the abundance 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.

## Conclusion

Based on this inventory and the authors' professional opinion, several management recommendations are made to secure and/or promote species diversity.

- 1) Construct temporary wildlife ponds in the riparian forest to promote *Ambystoma* spp. (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 refugia are available to harbor herpetofaunal 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.

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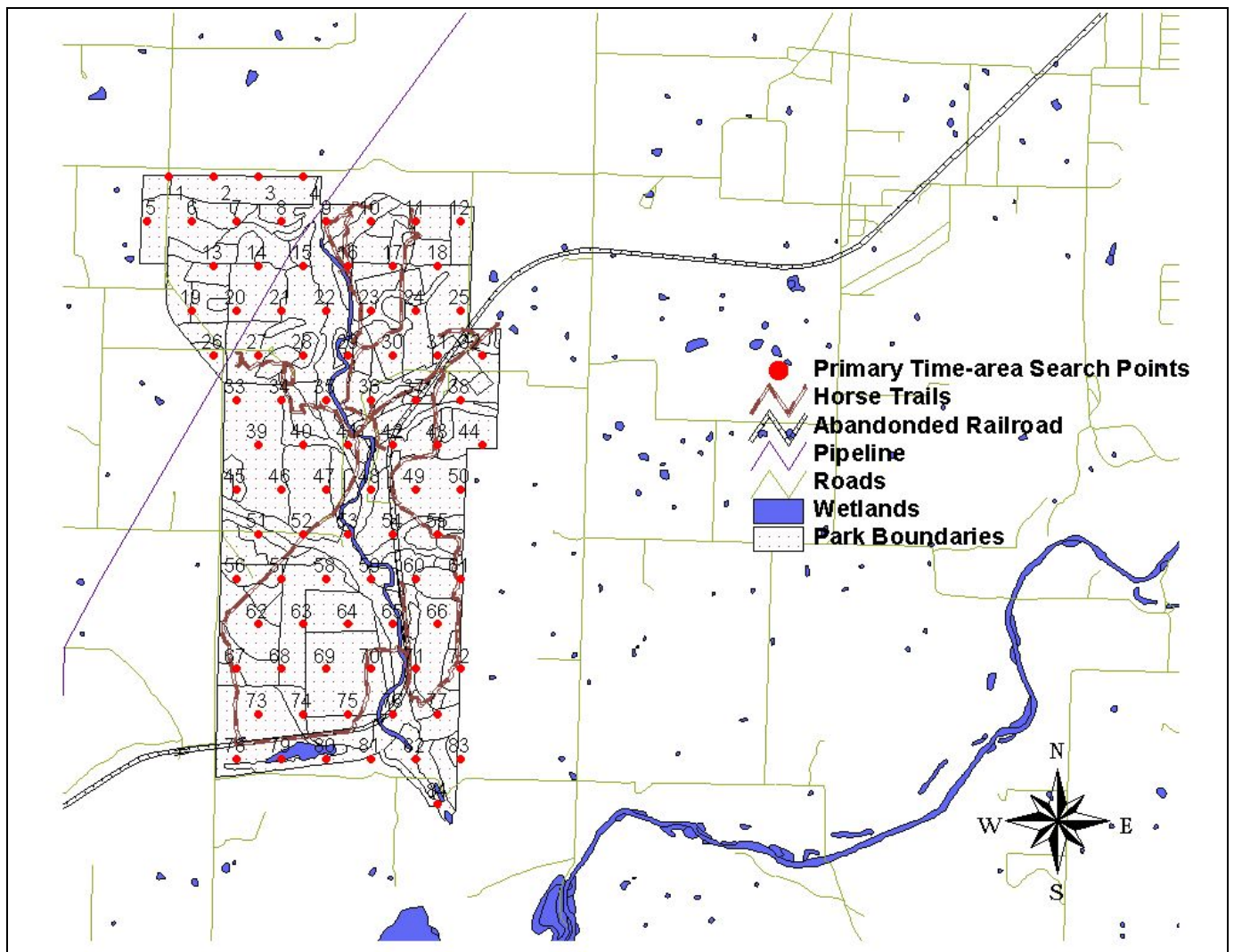


Figure 1. Wilson's Creek NB and associated spatial components.

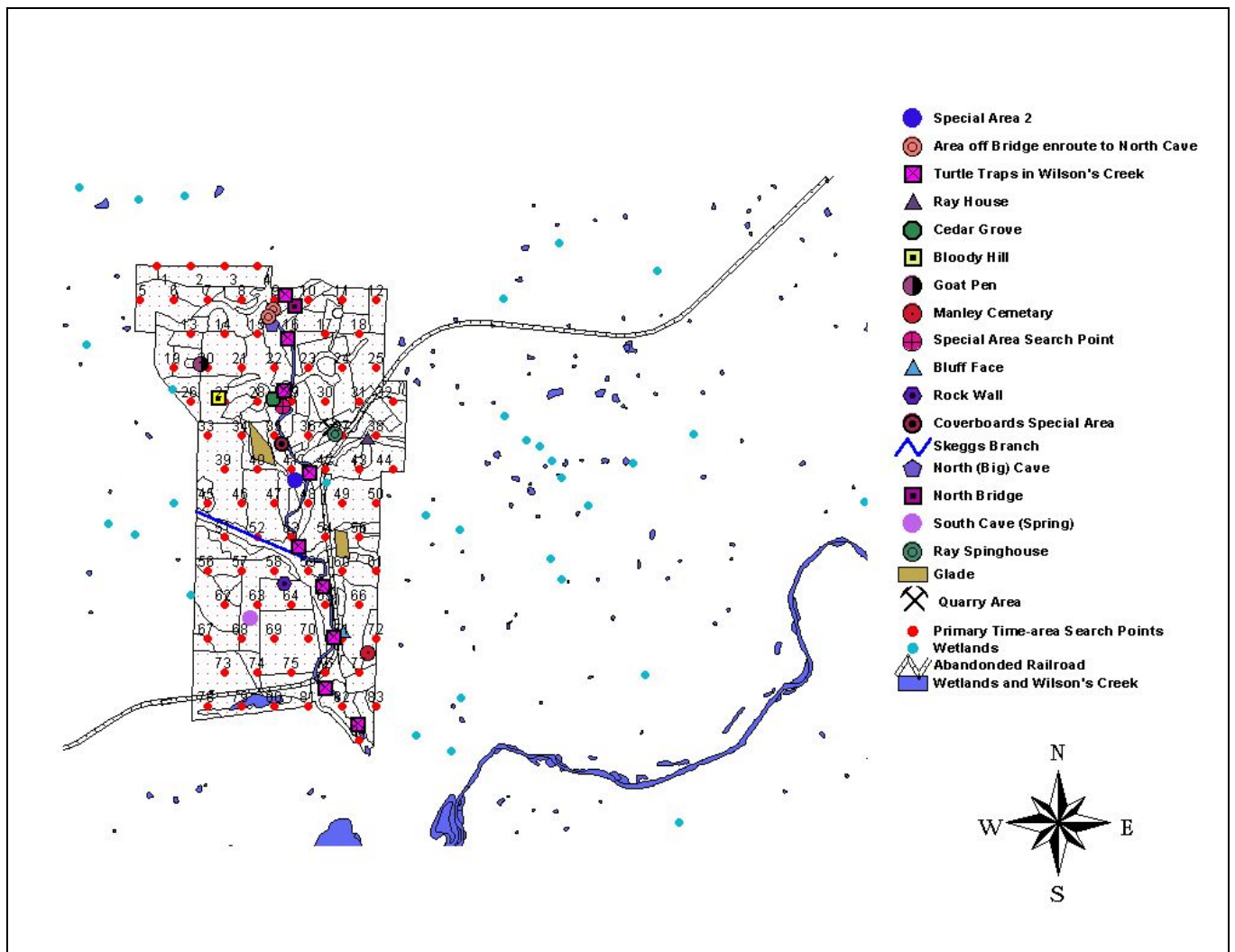


Figure 2. Special features and search areas at Wilson's Creek NB.

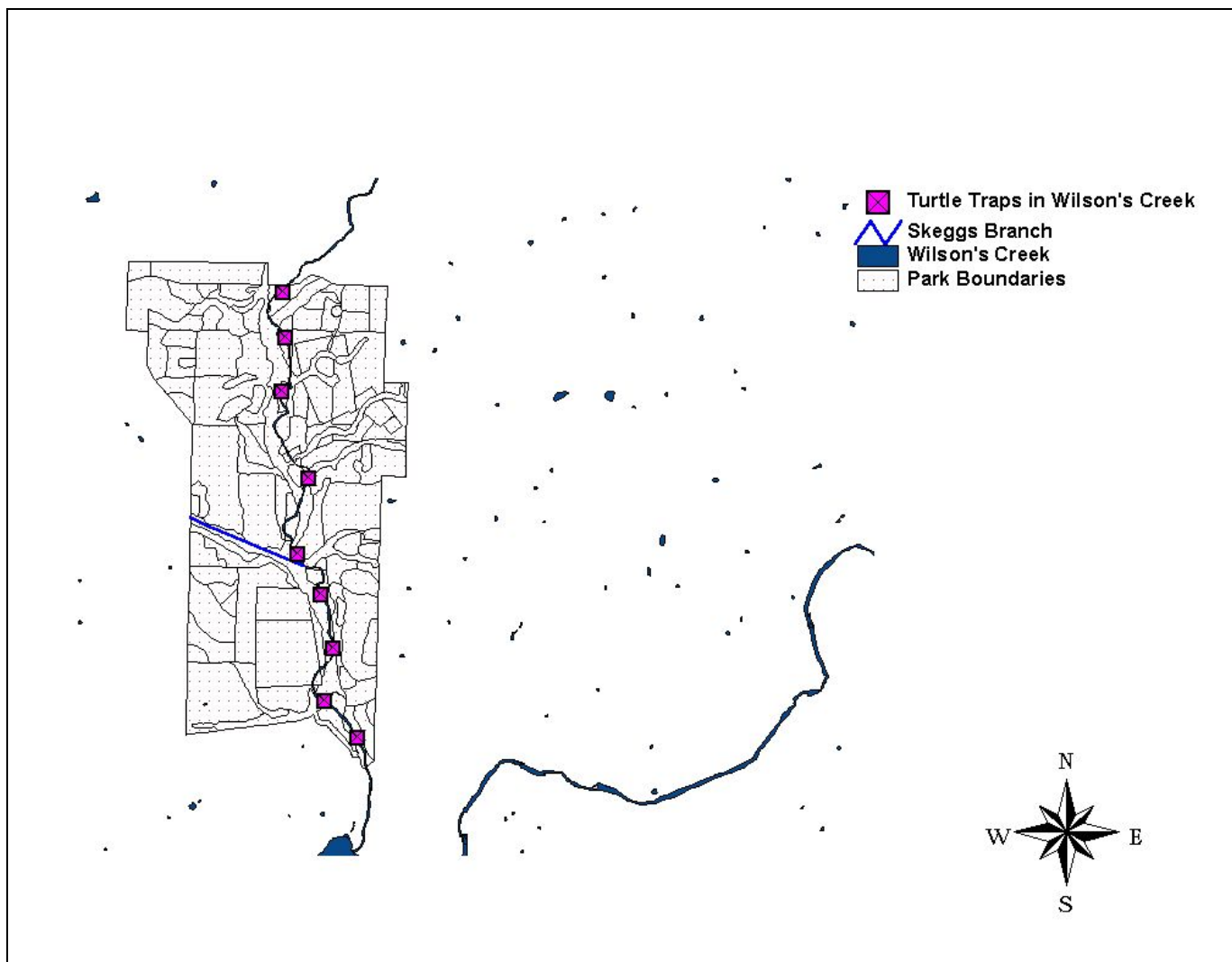


Figure 3. Relative positions of turtle traps along Wilson's Creek at Wilson's Creek NB.

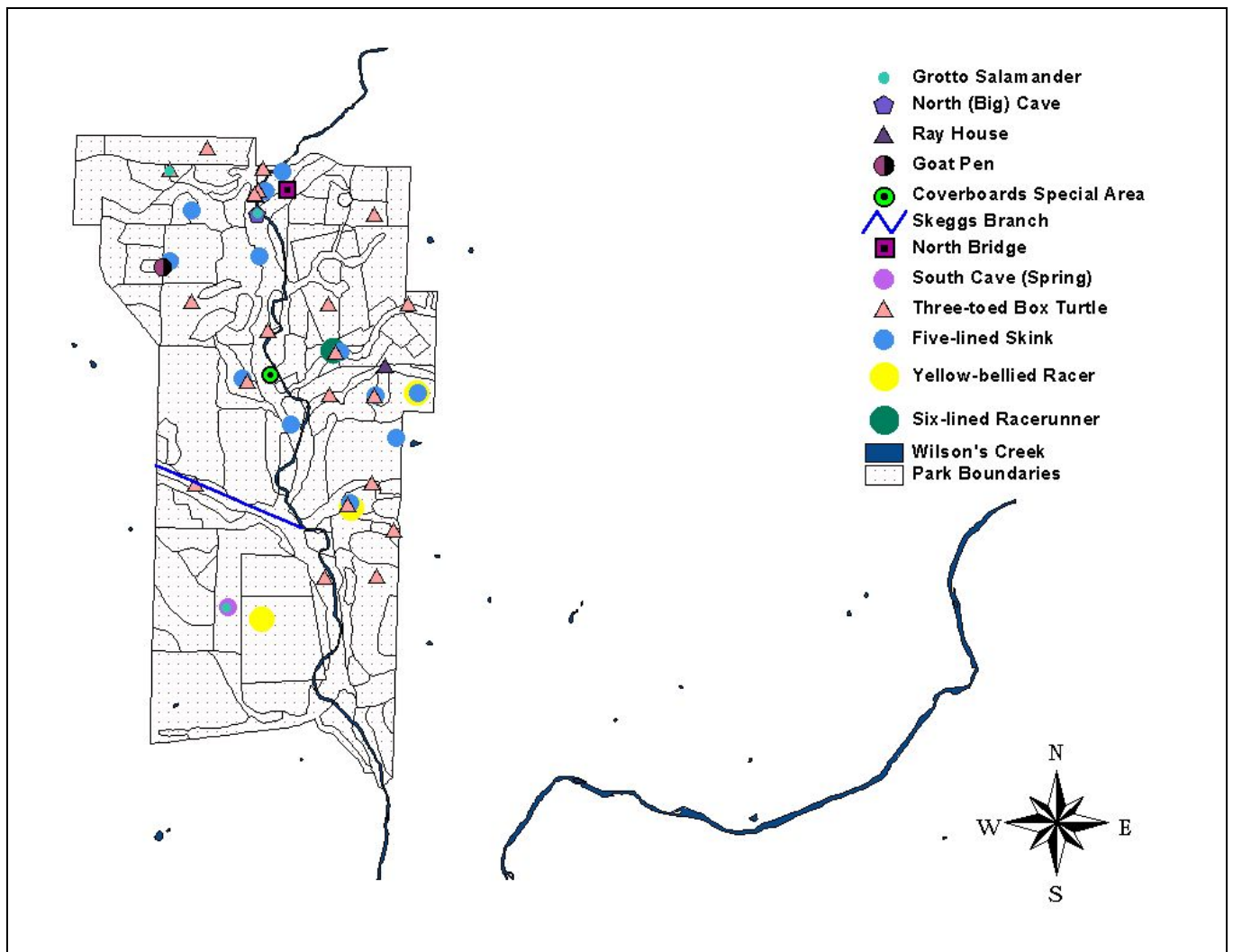


Figure 4. Distributions of five species of amphibians and reptiles at Wilson's Creek NB.

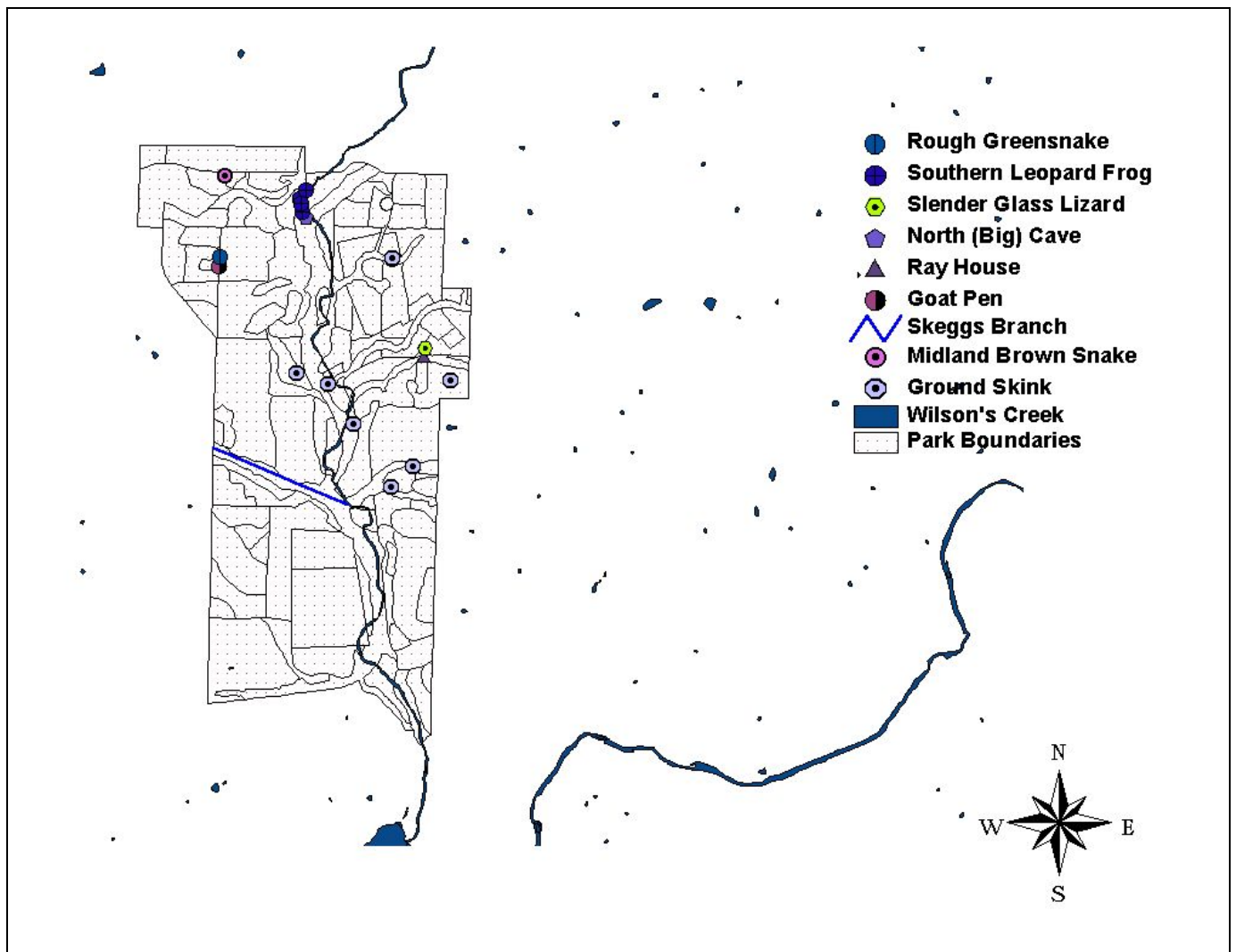


Figure 5. Distributions of five species of amphibians and reptiles at Wilson's Creek NB.

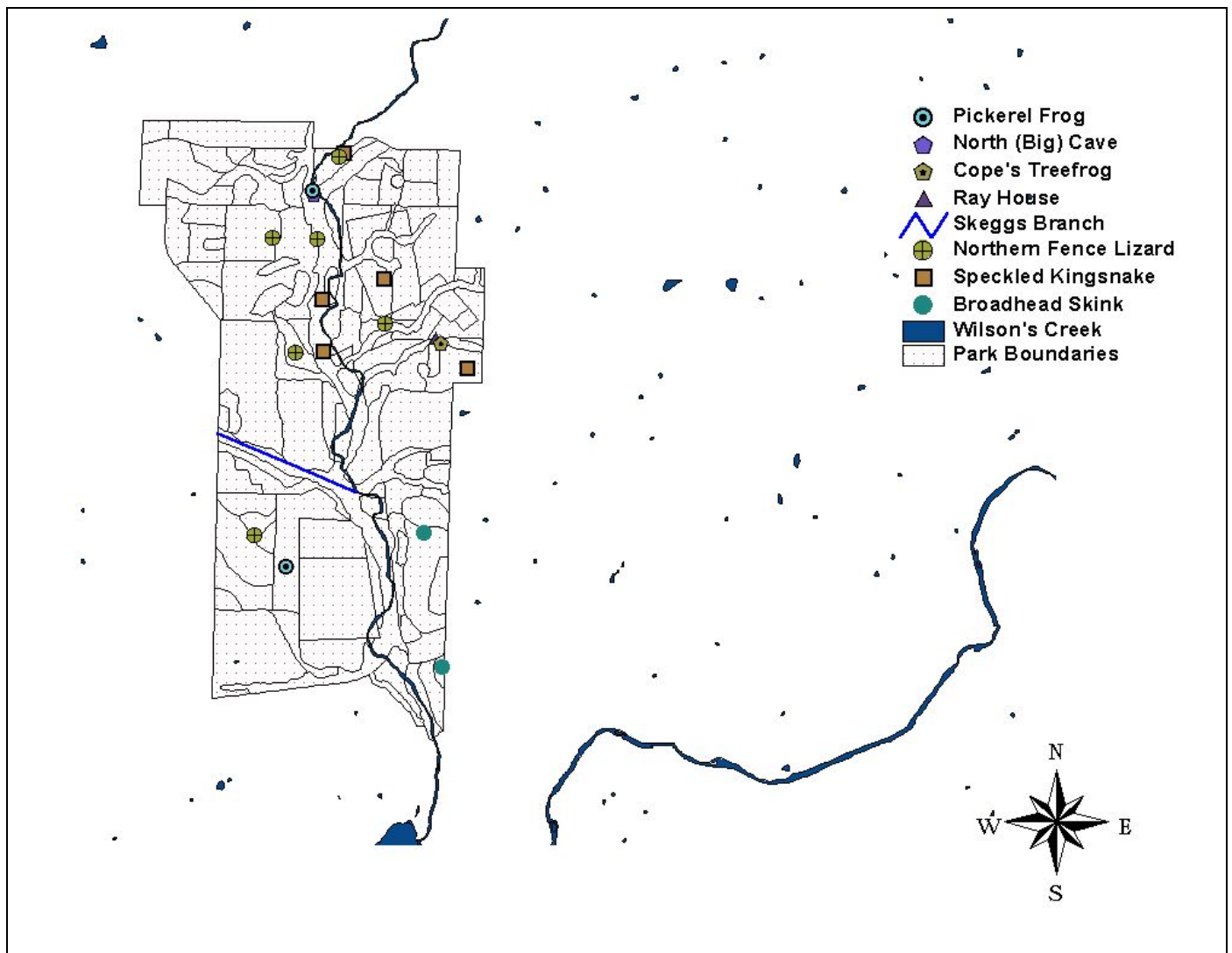


Figure 6. Distributions of five species of amphibians and reptiles at Wilson's Creek NB.

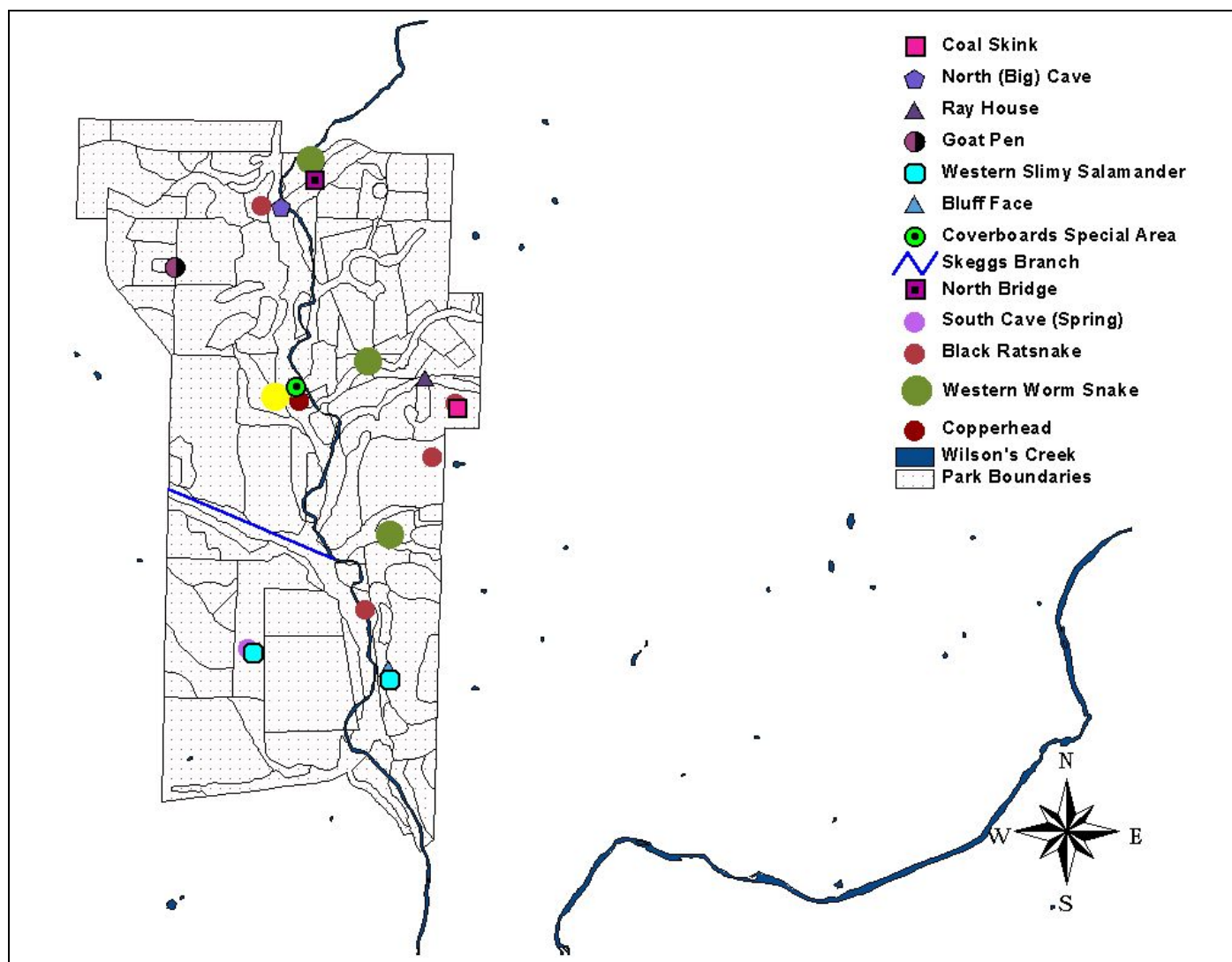


Figure 7. Distributions of five species of amphibians and reptiles at Wilson's Creek NB.

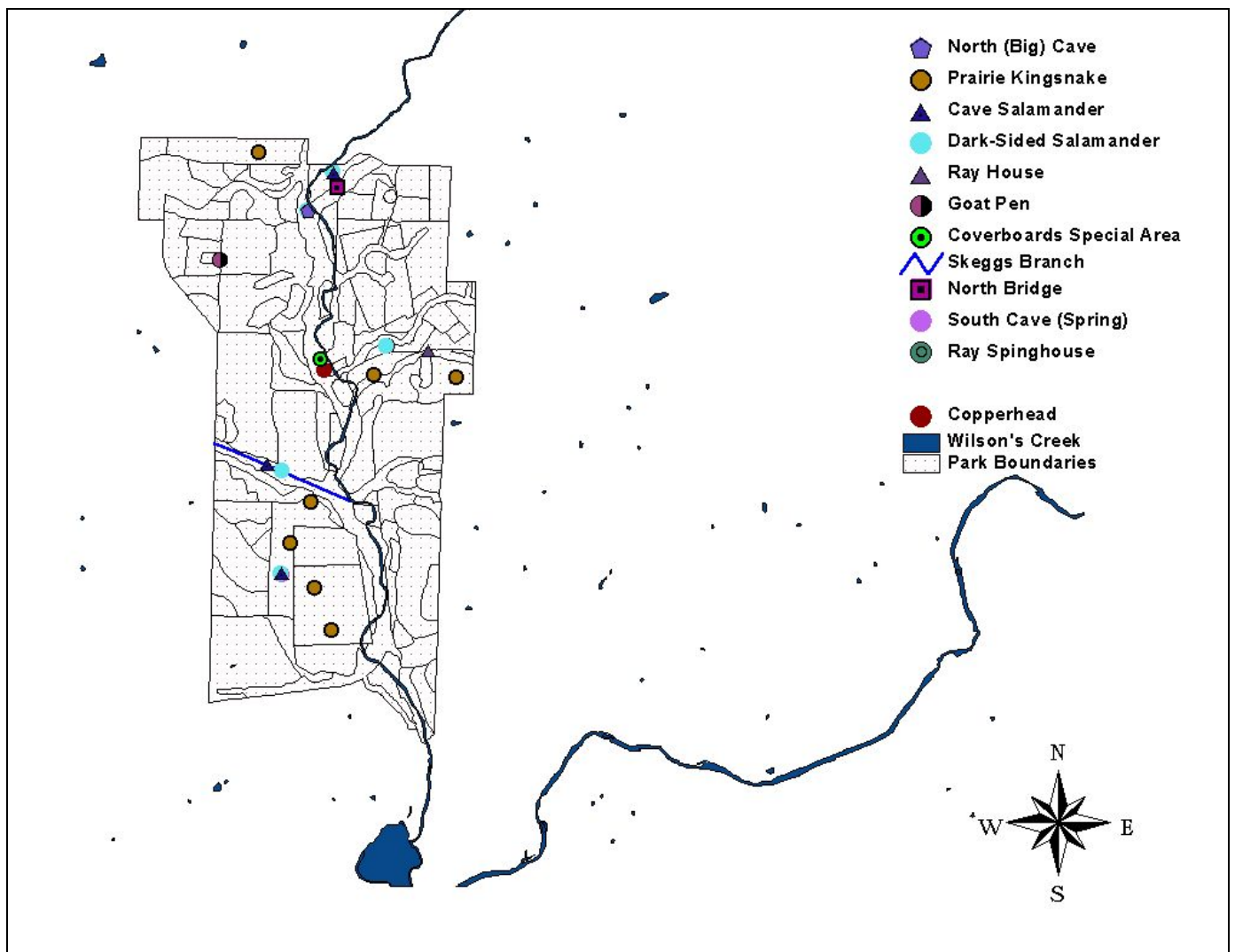


Figure 8. Distributions of four species of amphibians and reptiles at Wilson's Creek NB.

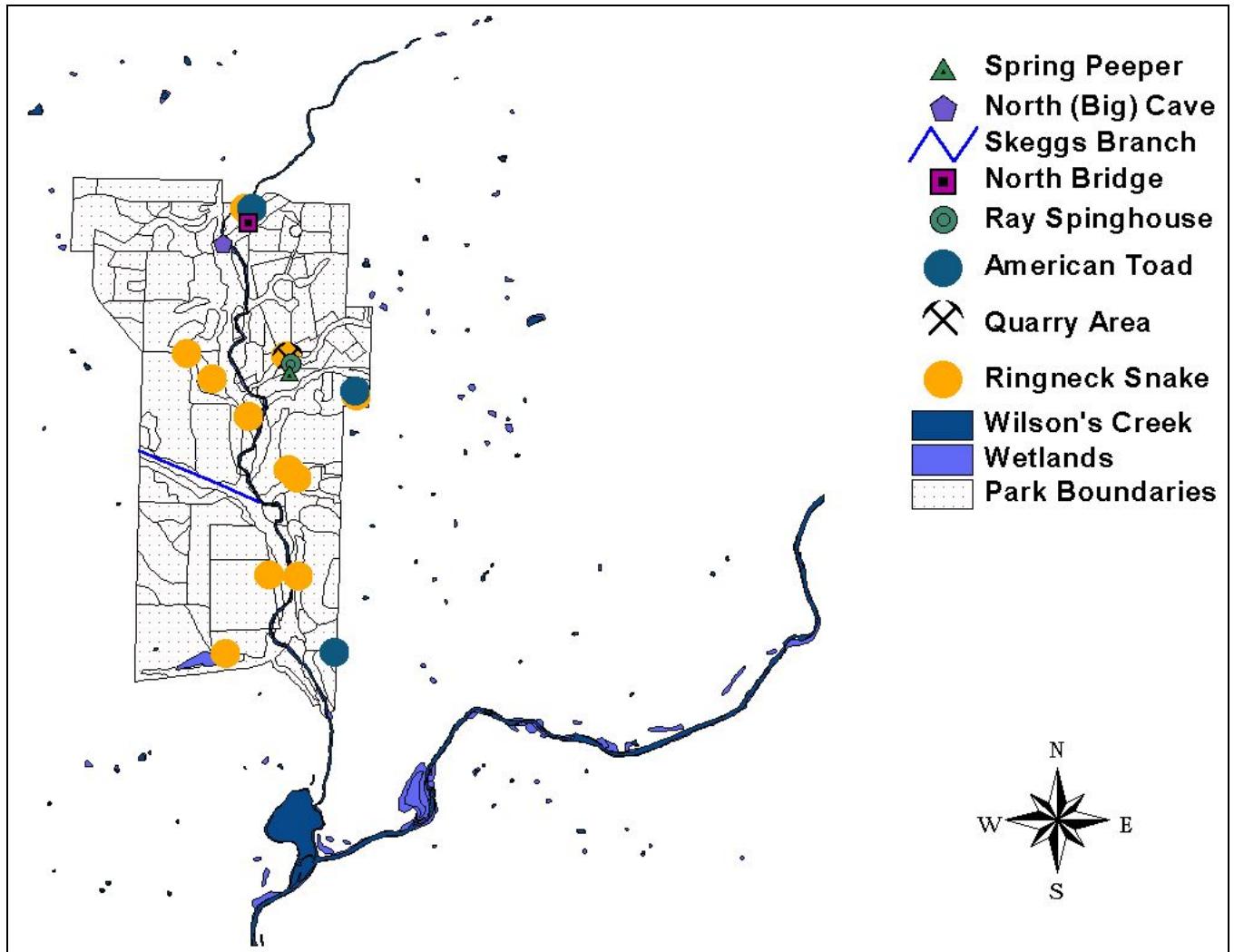


Figure 9. Distributions of three species of amphibians and reptiles from Wilson's Creek NB.

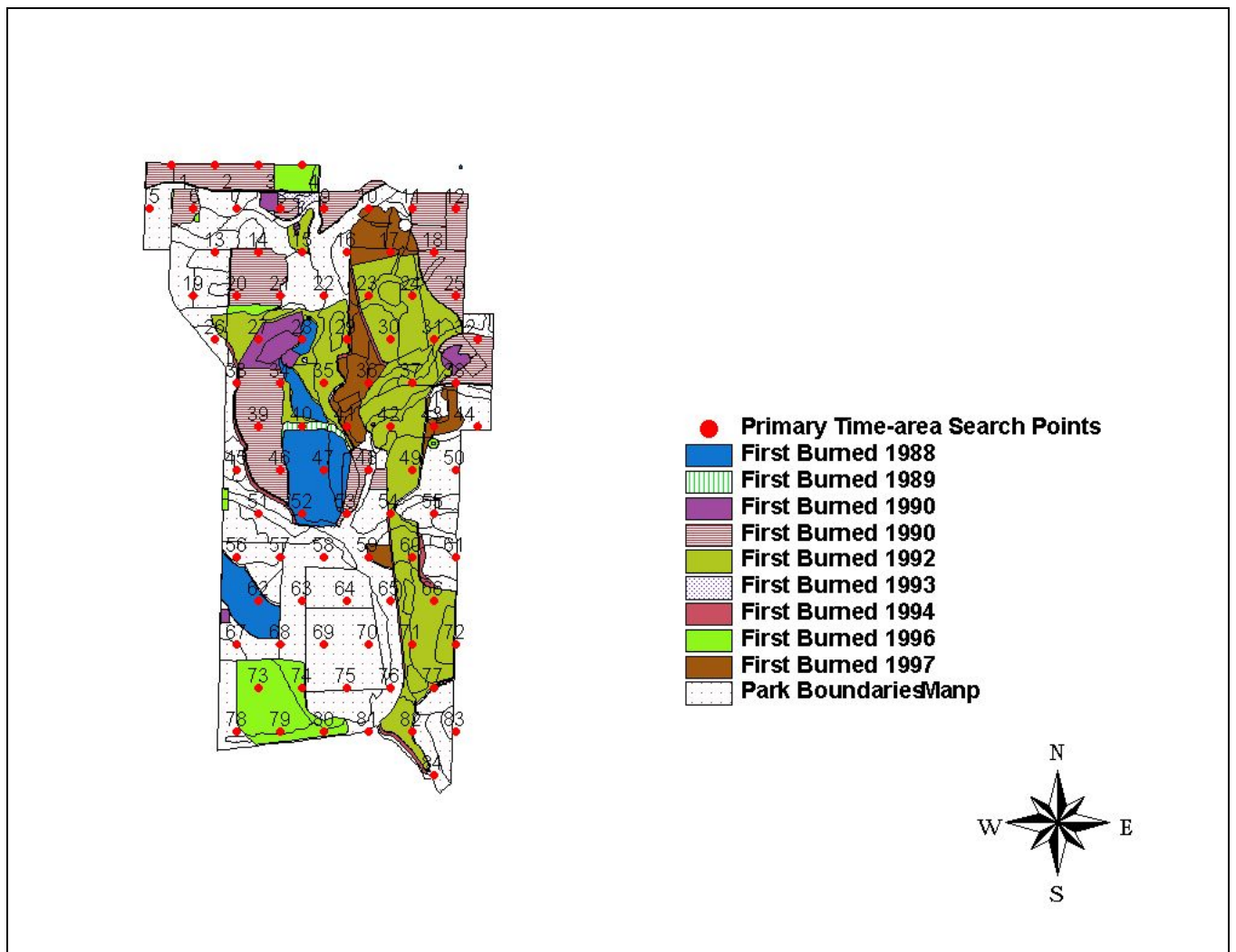


Figure 10. Dates and locations of initial prescribed burns at Wilson's Creek NB.

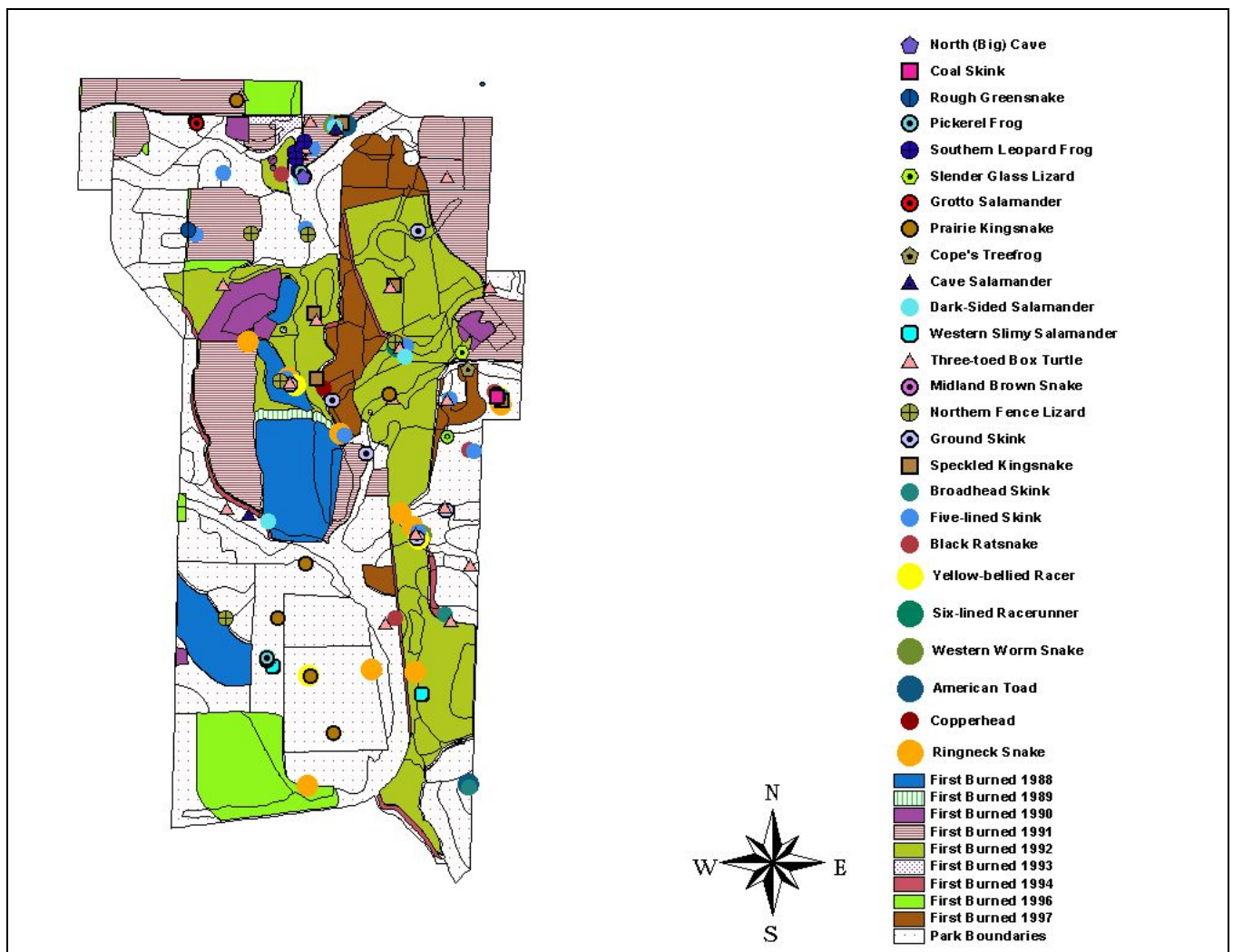


Figure 11. Overlay of the distributions of all amphibians and reptiles on initial prescribed burns at Wilson's Creek NB.

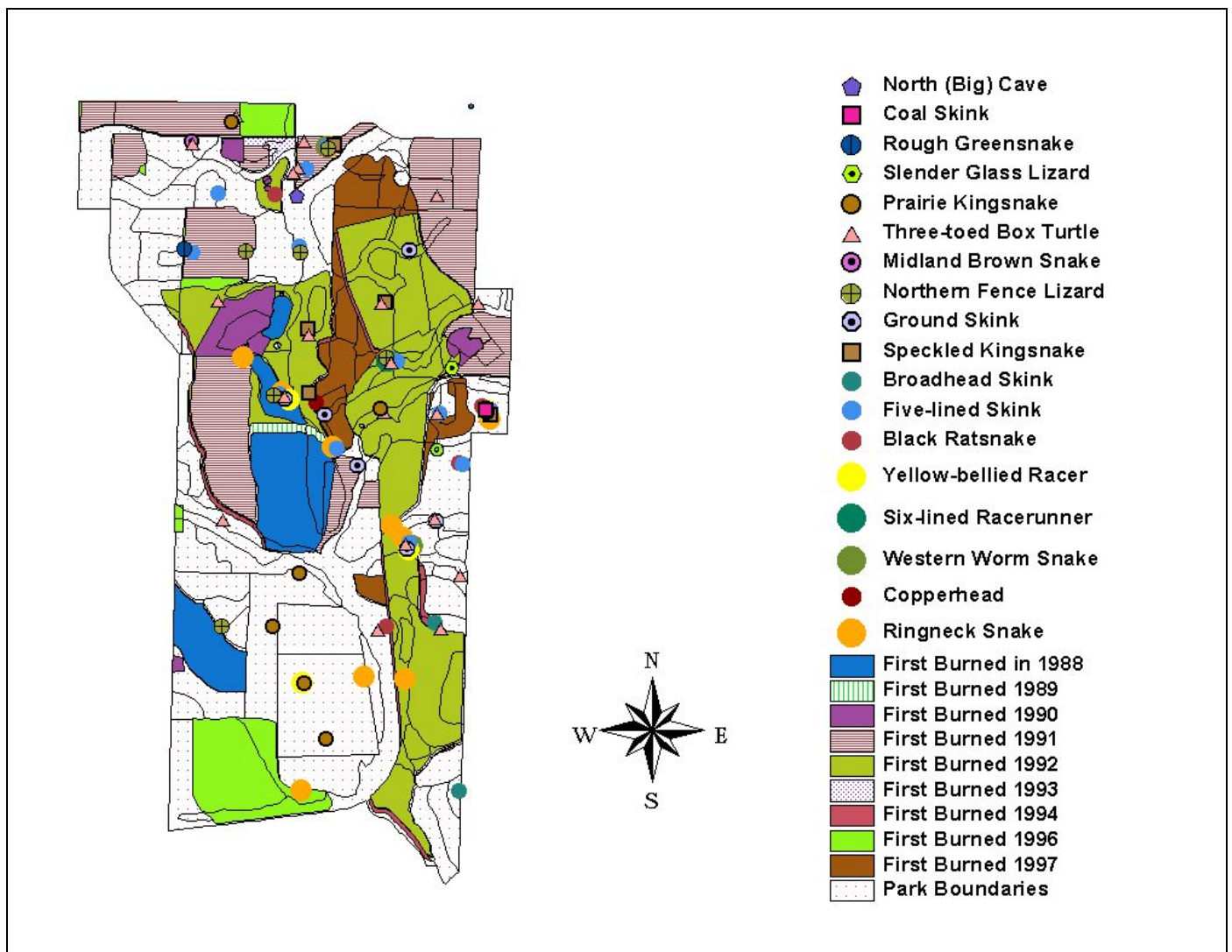


Figure 12. Distributions of reptiles in relation to onset of initial prescribed burns at Wilson's Creek NB.

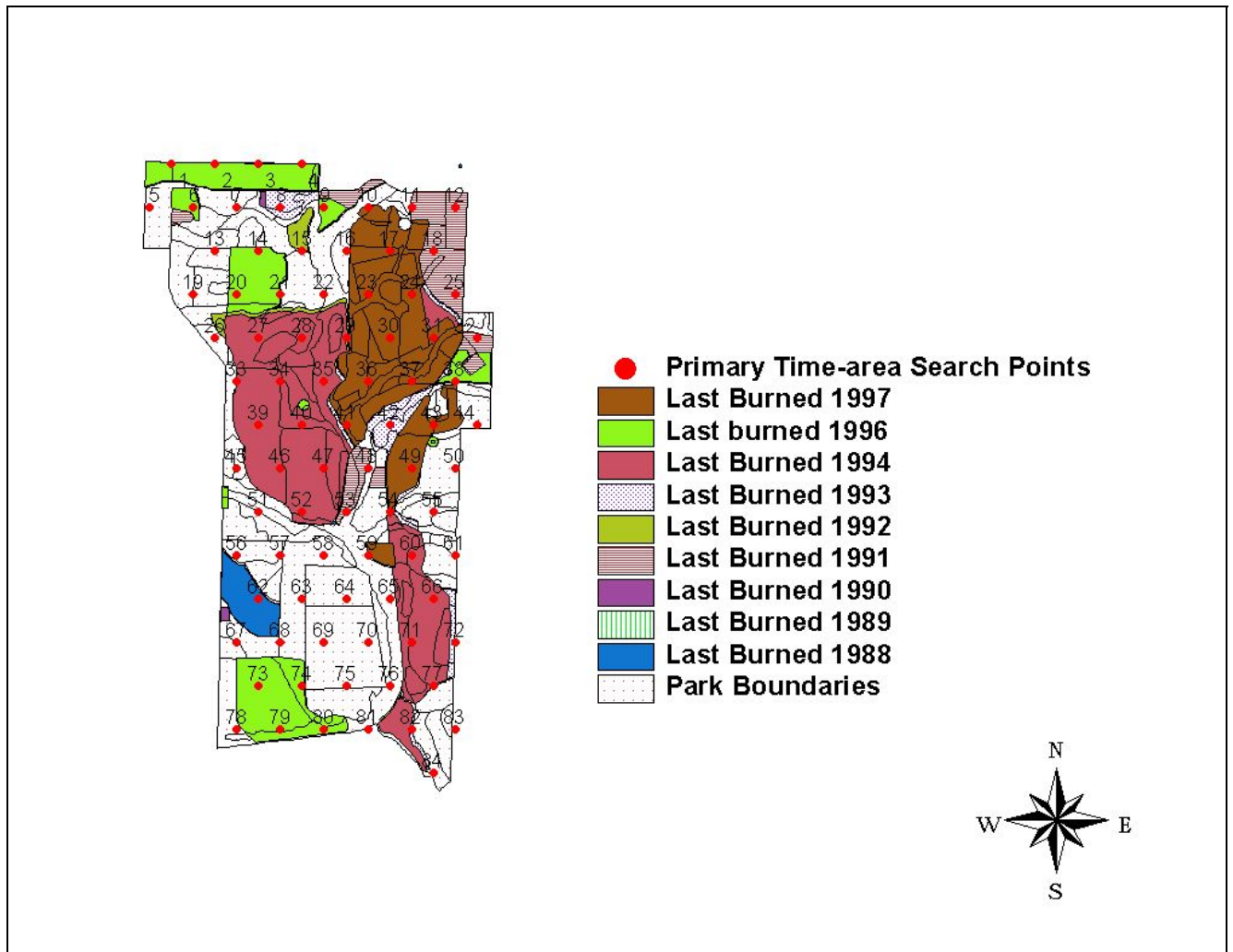


Figure 13. Distributions of most recent prescribed burns at Wilson's Creek NB.

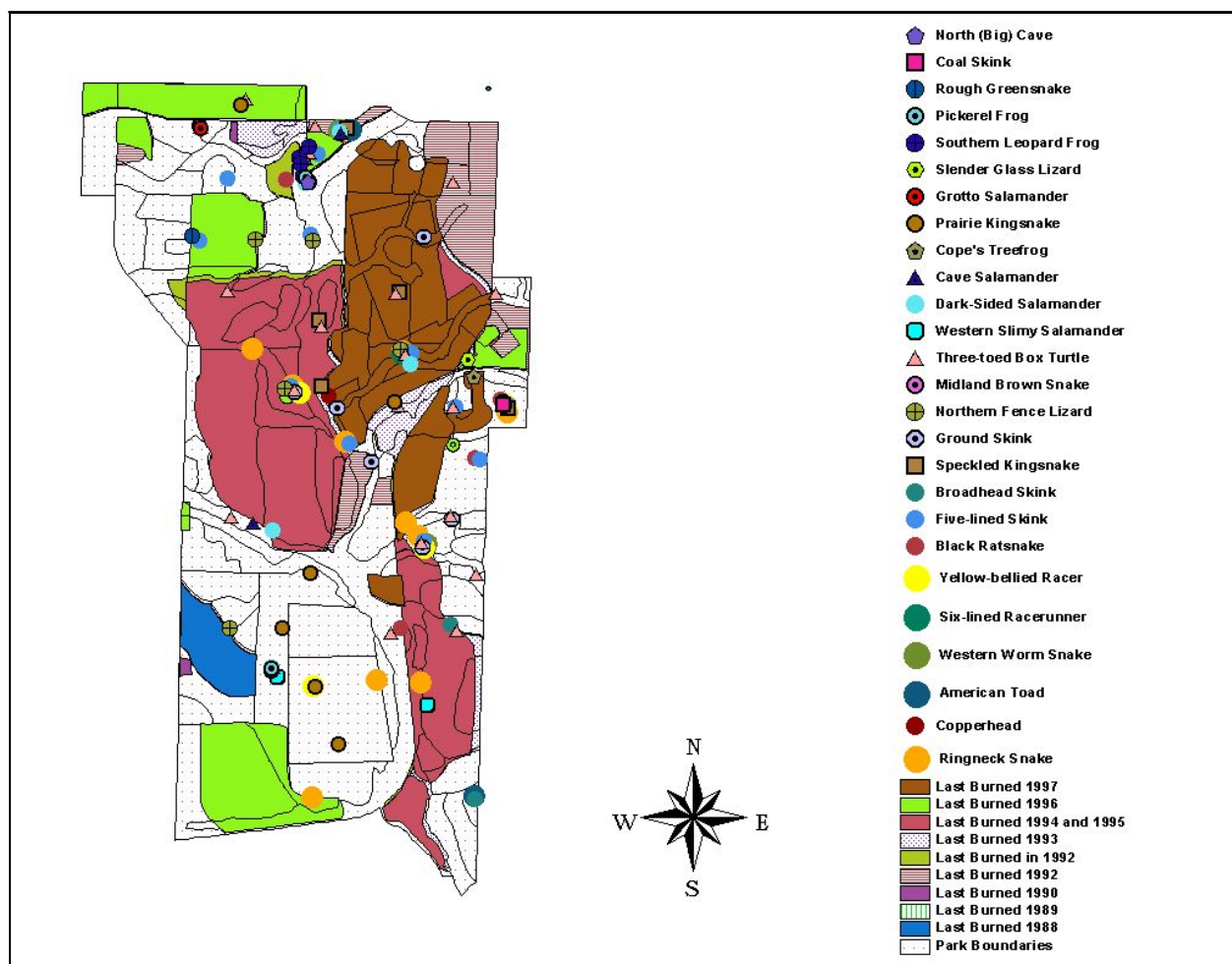


Figure 14. Distributions of all amphibians and reptiles in relation to most recent prescribed burns at Wilson's Creek NB.

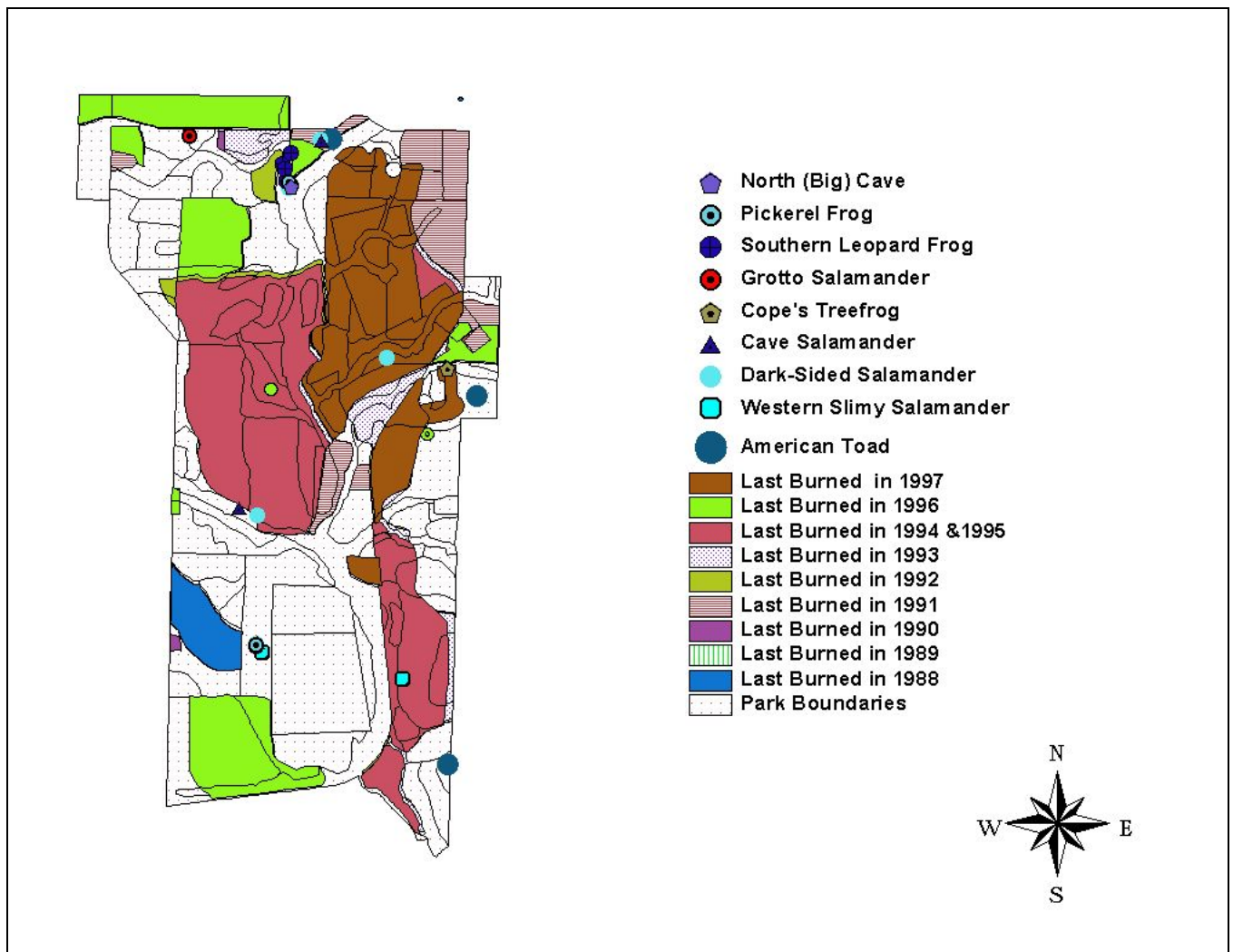


Figure 15. Distributions of amphibians in relation to most recent prescribed burns at Wilson's Creek NB.

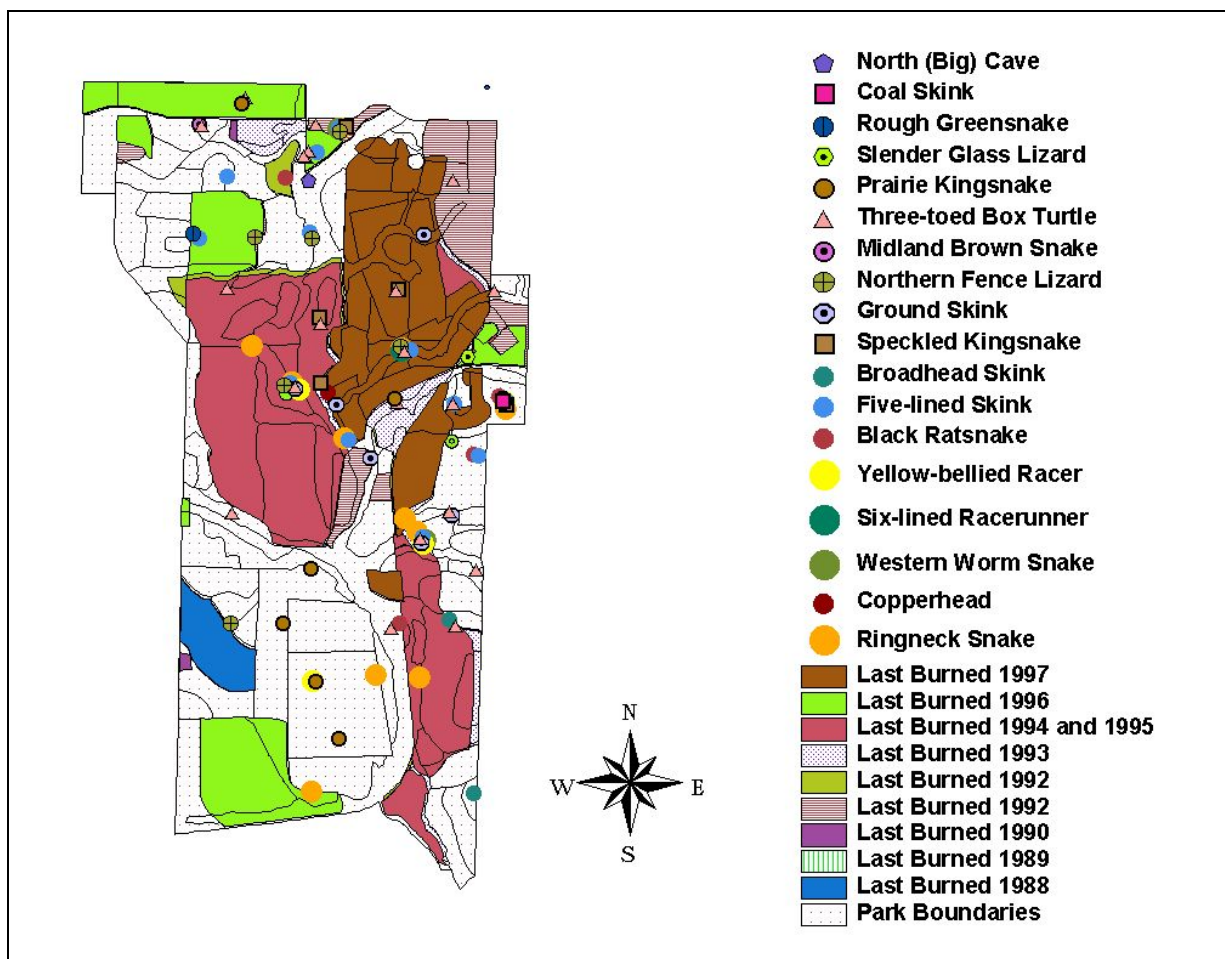


Figure 16. Distributions of reptiles in relation to most recent prescribed burns at Wilson's Creek NB.

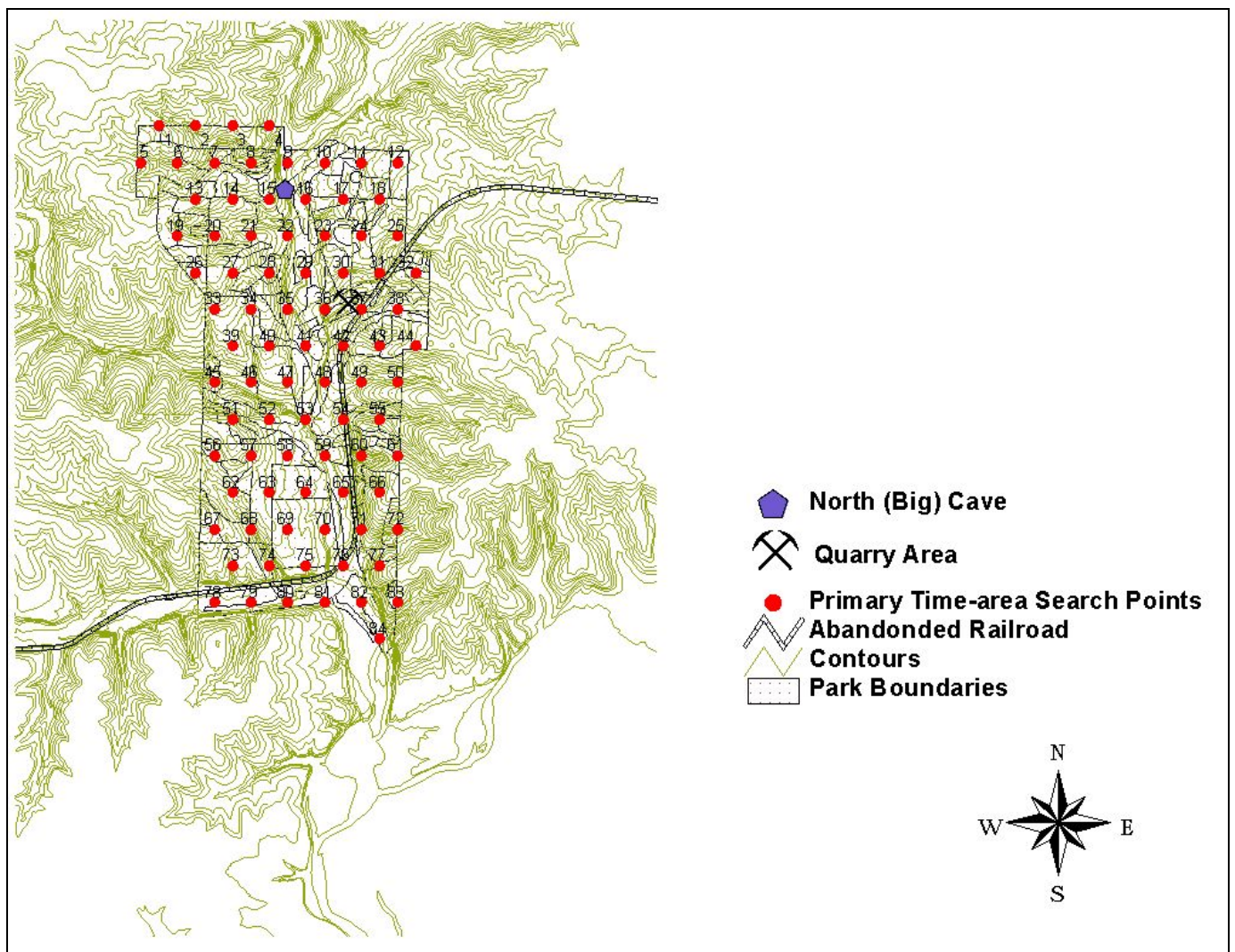


Figure 17. Relief contours of Wilson's Creek NB.

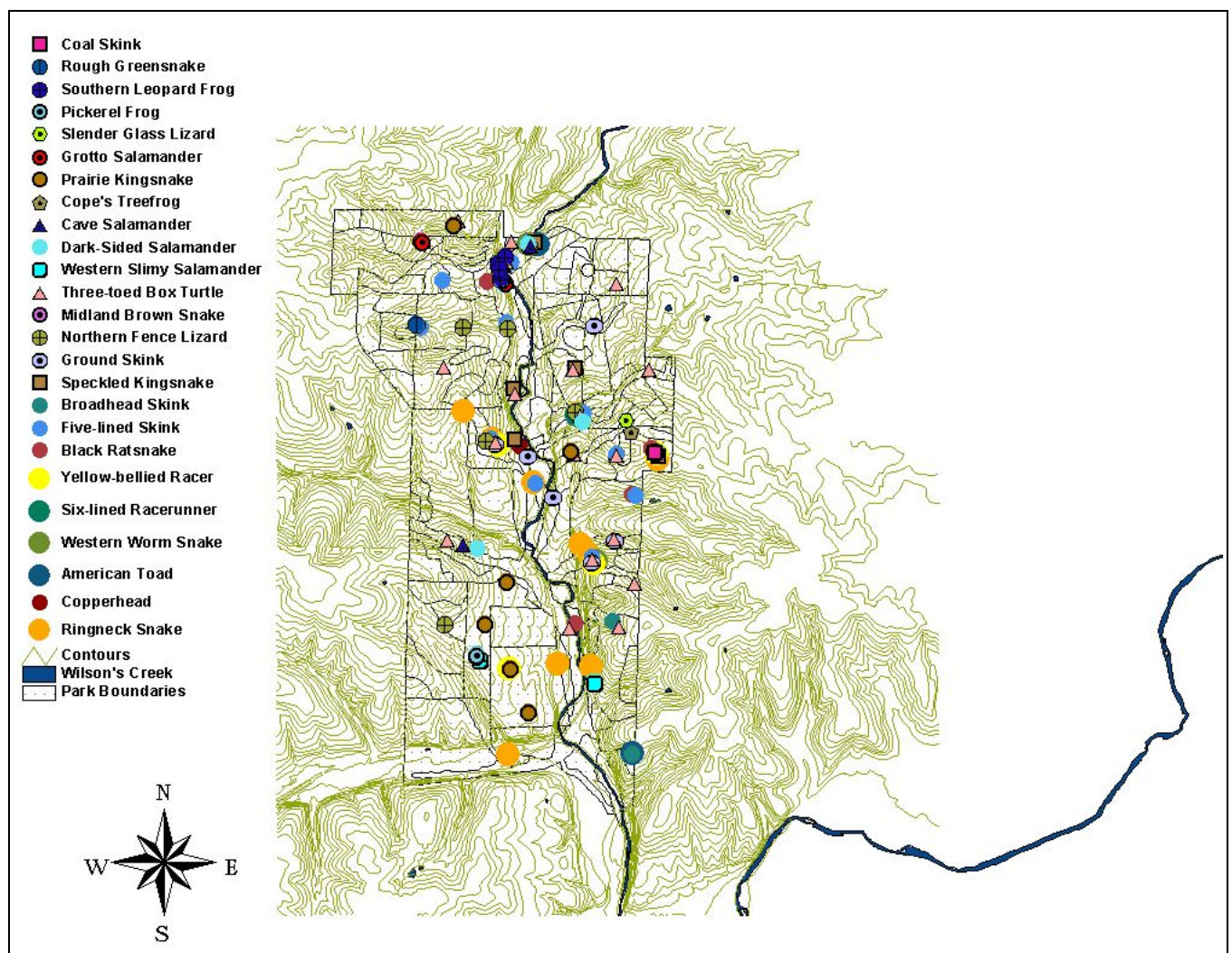


Figure 18. Distributions of amphibians and reptiles in relation to relief contours at Wilson's Creek NB.

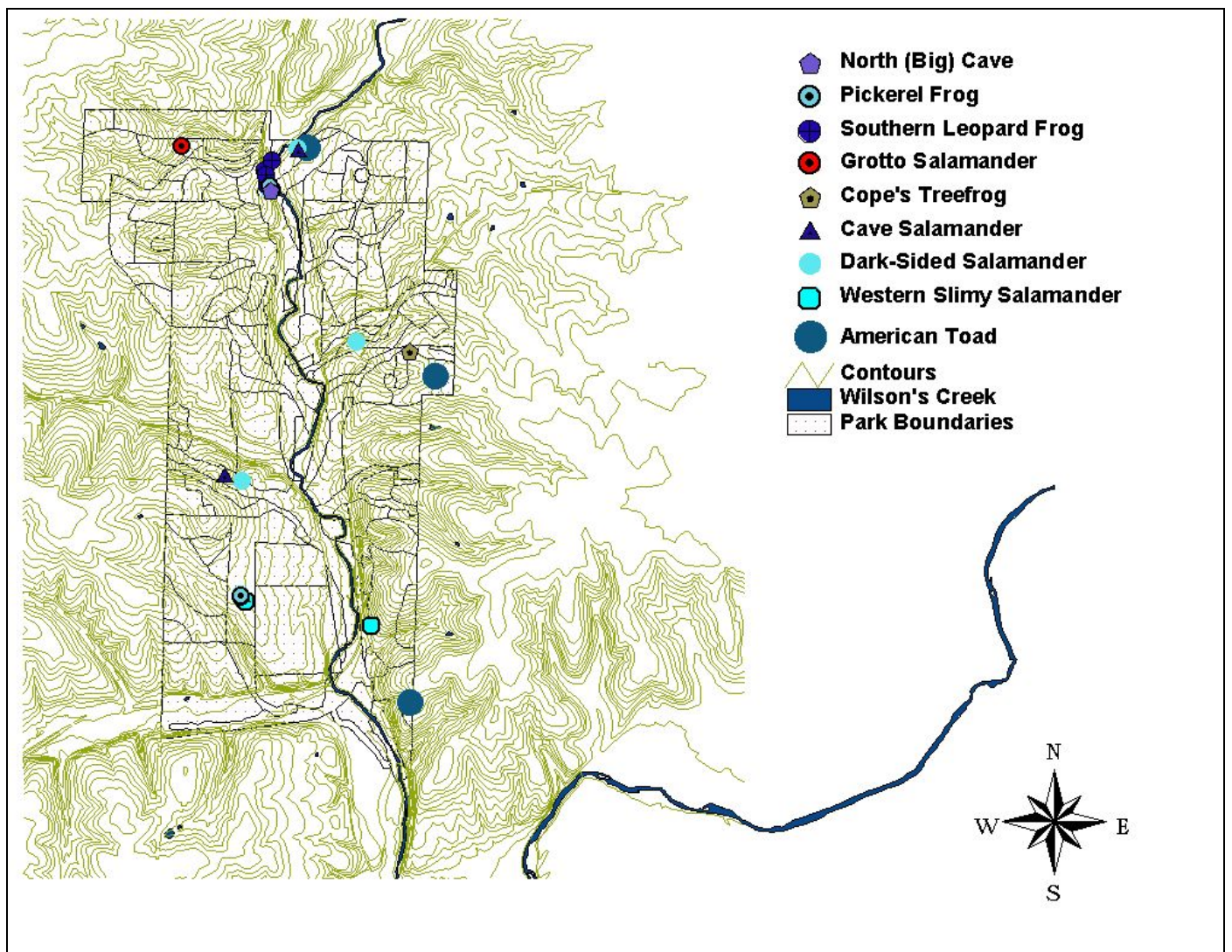


Figure 19. Distributions of amphibians in relation to relief at Wilson's Creek NB.

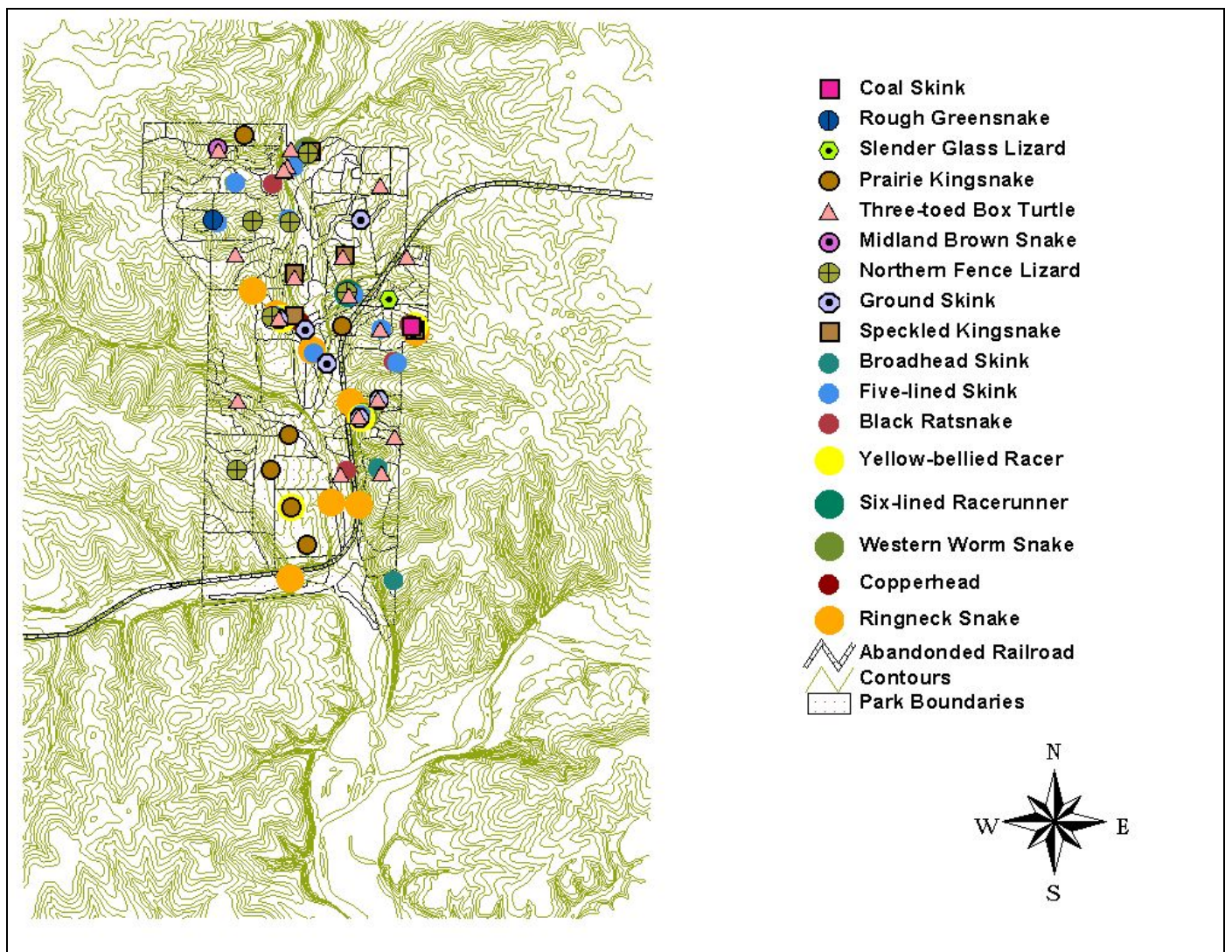


Figure 20. Distributions of reptiles in relation to relief at Wilson's Creek NB.

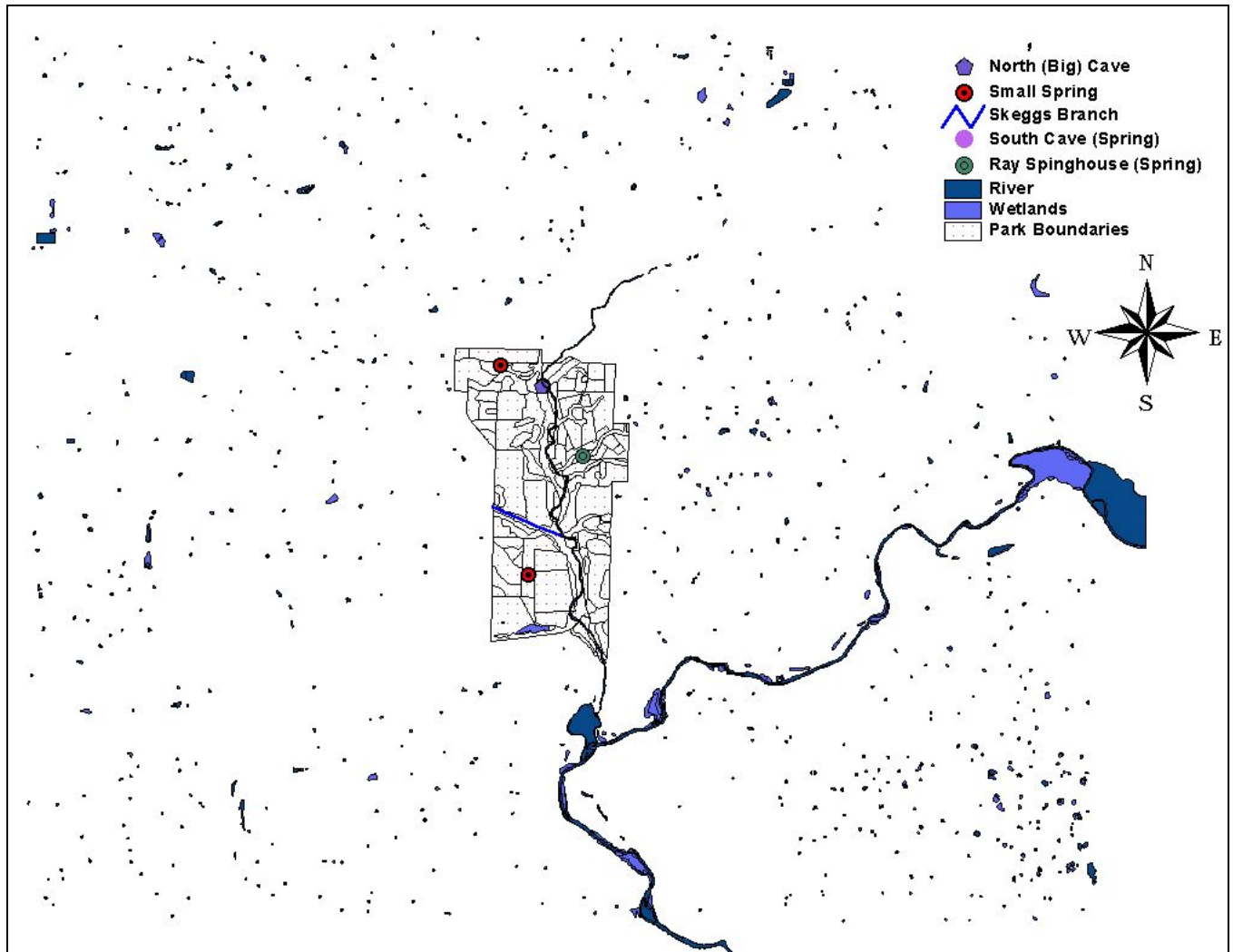


Figure 21. Lack of ponds on Wilson's Creek NB compared to the surrounding landscape.

Table 1. Amphibians and reptiles of Wilson's Creek NB.

Key: (+++++) = Commonly encountered, (+) = Rare, (?) = unverified observation

| <b>Class Amphibia</b> |                                         |                              |                           |
|-----------------------|-----------------------------------------|------------------------------|---------------------------|
| <b>Order Anura</b>    | <b>Scientific Name</b>                  | <b>Common Name</b>           | <b>Relative Abundance</b> |
| Bufonidae             | Bufo americanus<br>charlesmithi         | American toad                | +++                       |
| Hylidae               | Hyla chrysocelis                        | Cope's gray treefrog         | +                         |
|                       | Pseudacris crucifer crucifer            | Spring peeper                | +++                       |
| Ranidae               | Rana palustris                          | Pickerel frog                | +++                       |
|                       | Rana sphenoccephala                     | Southern leopard frog        | +++                       |
| <b>Order Caudata</b>  |                                         |                              |                           |
| Plethodontidae        | Eurycea longicauda<br>melanopleura      | Dark-sided salamander        | ++++                      |
|                       | Eurycea lucifuga                        | Cave salamander              | ++++                      |
|                       | Plethodon albagula                      | Western slimy salamander     | +                         |
|                       | Typhlotriton spelaeus                   | Grotto salamander            | +                         |
| <b>Class Reptilia</b> |                                         |                              |                           |
| <b>Order Squamata</b> |                                         |                              |                           |
| Anguidae              | Ophisaurus attenuatus<br>attenuatus     | Western slender glass lizard | ++                        |
| Colubridae            | Coluber constrictor<br>flaviventris     | Eastern yellowbelly racer    | +++                       |
|                       | Diadophis punctatus arnyi               | Prairie ringneck snake       | +++                       |
|                       | Elaphe obsoleta                         | Black rat snake              | ++                        |
|                       | Lampropeltis calligaster<br>calligaster | Prairie kingsnake            | +++                       |
|                       | Lampropeltis getula<br>holbrooki        | Speckled king snake          | +++                       |
|                       | Opheodrys aestivus<br>aestivus          | Rough green snake            | +                         |
|                       | Storeria dekayi                         | Brown snake                  | +                         |
|                       | Thamnophis sirtalis sirtalis            | Eastern garter snake         | +                         |
| Phrynosomatidae       | Sceloporus undulatus<br>hyacinthus      | Northern fence lizard        | ++++                      |
| Scincidae             | Eumeces fasciatus                       | Five-lined skink             | ++++                      |
|                       | Eumeces laticeps                        | Broadhead skink              | ++                        |
|                       | Scincella lateralis                     | Ground skink                 | +++++                     |
| Teiidae               | Cnemidophorus sexlineatus               | Six-lined racerunner         | ++                        |
| Viperidae             | Agkistrodon contortrix<br>phaeogaster   | Copperhead                   | +                         |
| Xenodontidae          | Carphophis vermis                       | Western worm snake           | +                         |
|                       |                                         |                              |                           |

Table 1. Amphibians and reptiles of Wilson's Creek NB (cont.).

| <b>Order</b>      | <b>Scientific Name</b>            | <b>Common Name</b>     | <b>Relative Abundance</b> |
|-------------------|-----------------------------------|------------------------|---------------------------|
| <b>Testudines</b> |                                   |                        |                           |
| Chelydridae       | Chelydra serpentina<br>serpentina | Common snapping turtle | ++                        |
| Emydidae          | Graptemys geographica             | Common map turtle      | ++                        |
|                   | Terrapene carolina<br>triunguis   | Three-toed box turtle  | +++++                     |
|                   | Trachemys scripta elegans         | Red-eared slider       | ++                        |

Table 2. Species richness at selected regions at Wilson's Creek NB.

| Species                 | Location                 |            |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 |           |
|-------------------------|--------------------------|------------|------------------|------------------|----------------------|-------------|---------------|-----------------|-----------------|-------------------|---------------|----------------------|------------|------------------|-----------------|-----------|
|                         | Eastern Restored Prairie | North Cave | Northeast Forest | Northwest Forest | Prairie Outside Park | Quarry Area | Ray Cornfield | Ray Springhouse | Riparian Forest | Sharp's Cornfield | Skeggs Branch | Skeggs Riparian Area | South Cave | Southeast Forest | Southeast Glade | West Pond |
| American toad           | X                        |            |                  |                  |                      |             |               |                 | X               |                   |               |                      |            | X                |                 |           |
| Black rat snake         | X                        |            | X                |                  |                      |             |               |                 | X               |                   |               |                      |            |                  |                 |           |
| Broadhead skink         |                          |            |                  |                  |                      |             |               |                 |                 |                   |               |                      | X          |                  |                 |           |
| Cave salamander         |                          |            |                  |                  |                      |             |               |                 | X               |                   | X             | X                    | X          |                  |                 |           |
| Coal skink              | X                        |            |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 |           |
| Common map snapper      |                          |            |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 | X         |
| Snapping turtle         |                          |            |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 | X         |
| Dark-sided salamander   |                          | X          |                  |                  |                      |             |               | X               | X               |                   | X             | X                    | X          |                  |                 |           |
| Eastern garter snake    |                          |            |                  |                  | X                    |             |               |                 |                 |                   |               |                      |            |                  |                 |           |
| E. yellowbelly racer    | X                        |            | X                |                  |                      |             |               |                 |                 | X                 |               |                      |            |                  |                 |           |
| Five-lined skink        | X                        |            | X                | X                |                      | X           | X             |                 | X               | X                 |               |                      |            |                  |                 |           |
| Grotto salamander       |                          | X          |                  |                  |                      |             |               |                 |                 |                   |               |                      | X          |                  |                 |           |
| Midland brown snake     | X                        |            | X                | X                |                      |             |               |                 |                 |                   |               |                      |            |                  |                 | X         |
| Northern copperhead     |                          |            |                  |                  |                      |             |               |                 | X               |                   |               |                      |            |                  |                 |           |
| Northern fence lizard   |                          |            |                  |                  |                      | X           | X             |                 | X               |                   |               |                      |            |                  |                 | X         |
| Pickrel frog            |                          | X          |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 |           |
| Prairie kingsnake       | X                        |            |                  |                  | X                    |             |               |                 |                 | X                 |               |                      |            |                  |                 |           |
| Prairie ringneck snake  | X                        |            | X                |                  |                      | X           |               |                 | X               | X                 |               |                      |            | X                | X               |           |
| Red-eared slider        |                          |            |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 | X         |
| Rough green snake       |                          |            |                  | X                |                      |             |               |                 |                 |                   |               |                      |            |                  |                 |           |
| Six-lined racerunner    |                          |            |                  |                  |                      | X           |               |                 |                 |                   |               |                      |            |                  |                 |           |
| Southern leopard frog   |                          | X          |                  |                  |                      |             |               |                 | X               |                   |               |                      |            |                  |                 |           |
| Speckled kingsnake      | X                        |            |                  |                  |                      |             | X             |                 | X               |                   |               |                      |            |                  |                 |           |
| Spring peeper           |                          |            |                  |                  |                      |             |               | X               |                 |                   |               |                      |            |                  |                 |           |
| Three-toed box turtle   | X                        |            | X                | X                | X                    | X           | X             |                 | X               |                   |               | X                    |            | X                | X               | X         |
| W. slender glass lizard | X                        |            |                  |                  |                      |             |               |                 |                 |                   |               |                      |            |                  |                 |           |
| W. slimy salamander     |                          |            |                  |                  |                      |             |               |                 |                 |                   |               |                      | X          | X                |                 |           |
| Western worm snake      |                          |            | X                |                  |                      | X           |               |                 | X               |                   |               |                      |            |                  |                 |           |
| <b>Total</b>            | 11                       | 4          | 7                | 4                | 3                    | 6           | 4             | 2               | 13              | 4                 | 2             | 3                    | 4          | 5                | 2               | 1         |

Table 3. Species richness in seven major habitat types at Wilson's Creek NB.

| Species                   | Habitat Type  |            |      |                   |                       |                 |               |
|---------------------------|---------------|------------|------|-------------------|-----------------------|-----------------|---------------|
|                           | Caves/Springs | Grasslands | Pond | Littoral habitats | Quarry/Restored Glade | Riparian Forest | Upland Forest |
| American toad             |               |            |      |                   |                       | X               |               |
| Black rat snake           |               | X          |      |                   |                       | X               | X             |
| Cave salamander           | X             |            |      | X                 |                       | X               |               |
| Coal skink                |               | X          |      |                   |                       |                 |               |
| Common map turtle         |               |            |      | X                 |                       |                 |               |
| Common snapping turtle    |               |            |      | X                 |                       |                 |               |
| Dark-sided salamander     | X             |            |      | X                 |                       | X               |               |
| Eastern garter snake      |               | X          |      |                   |                       |                 |               |
| Eastern yellowbelly racer |               | X          |      |                   |                       |                 | X             |
| Five-lined skink          |               | X          |      |                   | X                     | X               | X             |
| Grotto salamander         | X             |            |      |                   |                       |                 |               |
| Midland brown snake       |               |            |      |                   |                       | X               | X             |
| Northern copperhead       |               |            |      |                   |                       | X               |               |
| Northern fence lizard     |               | X          |      |                   | X                     | X               | X             |
| Pickerel frog             | X             |            |      |                   |                       |                 |               |
| Prairie kingsnake         |               | X          |      |                   |                       |                 |               |
| Prairie ringneck snake    |               | X          |      |                   | X                     | X               |               |
| Red-eared slider          |               |            |      | X                 |                       |                 |               |
| Rough green snake         |               |            |      |                   |                       |                 | X             |
| Six-lined racerunner      |               |            |      |                   | X                     |                 |               |
| Southern leopard frog     | X             |            |      |                   |                       | X               |               |
| Speckled kingsnake        |               | X          |      |                   |                       | X               |               |
| Three-toed box turtle     |               | X          | X    |                   | X                     | X               | X             |
| W. slender glass lizard   |               | X          |      |                   |                       |                 |               |
| Western worm snake        |               |            |      |                   | X                     | X               | X             |
| <b>Total</b>              | 5             | 11         | 1    | 5                 | 6                     | 13              | 8             |

Table 4. List of amphibians expected and current status of occurrence at Wilson's Creek NB.

| <b>Order Caudata</b>  | <b>Scientific Name</b>            | <b>Common Name</b>       | <b>Old</b> | <b>New</b> | <b>Trauth</b> |
|-----------------------|-----------------------------------|--------------------------|------------|------------|---------------|
| Ambystomatidae        | Ambystoma annulatum               | Ringed salamander        | 1          | 0          | No            |
|                       | Ambystoma maculatum               | Spotted salamander       | 1          | 0          | No            |
|                       | Ambystoma tigrinum                | E. tiger salamander      | 1          | 0          | No            |
| Plethodontidae        | Eurycea longicauda melanopleura   | Dark-sided salamander    | 1          | 2          | Yes           |
|                       | Eurycea lucifuga                  | Cave salamander          | 1          | 2          | Yes           |
|                       | Eurycea multiplicata              | Many-ribbed salamander   | 1          | 0          | No            |
|                       | Eurycea multiplicata griesogaster | Graybelly salamander     | na         | 1          | No            |
|                       | Plethodon albagula                | W. slimy salamander      | 0          | 2          | Yes           |
|                       | Plethodon angusticlavius          | Zigzag salamander        | 1          | 1          | No            |
|                       | Typhlotriton spelaeus             | Grotto salamander        | 1          | 2          | Yes           |
| Proteidae             | Necturus maculosus louisianensis  | Mudpuppy                 | 1          | 4          | No            |
| Salamandridae         | Notophthalmus viridescens         | Central newt             | 1          | 0          | No            |
| <b>Order Salienta</b> |                                   |                          |            |            |               |
| Bufonidae             | Bufo americanus charlesmithi      | American toad            | 1          | 2          | Yes           |
|                       | Bufo woodhousii fowleri           | Woodhouse's toad         | 1          | ?          | No            |
| Hylidae               | Acris crepitans blanchardii       | Cricket frog             | 1          | 4          | No            |
|                       | Hyla chrysoscelis                 | Gray treefrog            | 1          | 2          | Yes           |
|                       | Pseudacris crucifer crucifer      | Northern spring peeper   | 1          | 2          | Yes           |
|                       | Pseudacris triseriata             | Western chorus frog      | 1          | 4          | No            |
| Microhylidae          | Gastrophryne carolinensis         | Eastern narrowmouth toad | 1          | 4          | No            |
| Ranidae               | Rana catesbeiana                  | Bullfrog                 | 1          | 0          | No            |
|                       | Rana clamitans clamitans          | Green frog               | 1          | 0          | No            |
|                       | Rana palustris                    | Pickerel frog            | 1          | 2          | Yes           |
|                       | Rana 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 5. List of reptiles expected and current status of occurrence at Wilson's Creek NB.

| <b>Order Squamata</b>   | <b>Scientific Name</b>                        | <b>Common Name</b>      | <b>Old</b> | <b>New</b> | <b>Trauth</b> |
|-------------------------|-----------------------------------------------|-------------------------|------------|------------|---------------|
| Anguidae                | Ophisaurus attenuatus attenuatus              | Slender glass lizard    | 1          | 2          | Yes           |
| Colubridae              | Coluber constrictor flaviventris              | Racer                   | 1          | 2          | Yes           |
|                         | Diadophis punctatus arnyi                     | Ringneck snake          | 1          | 2          | Yes           |
|                         | Elaphe guttata emoryi                         | 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 calligaster          | Prairie kingsnake       | 1          | 2          | Yes           |
|                         | Lampropeltis getula holbrooki                 | Speckled kingsnake      | 1          | 2          | Yes           |
|                         | Lampropeltis triangulum                       | Milk snake              | 1          | 0          | No            |
|                         | Masticophis flagellum flagellum               | Eastern coachwhip       | 1          | 1          | No            |
|                         | Nerodia rhombifer rhombifer                   | Diamondback water snake | 0          | 1          | No            |
|                         | Nerodia sipedon                               | Northern water snake    | 1          | 0          | No            |
|                         | Opheodrys aestivus aestivus                   | Rough green snake       | 1          | 2          | Yes           |
|                         | Pituophis catenifer sayi                      | Bull snake              | 1          | 1          | No            |
|                         | Sonora semiannulata                           | Ground snake            | 1          | 0          | No            |
|                         | Storeria dekayi                               | Brown snake             | 1          | 2          | Yes           |
|                         | Storeria occipitomaculata<br>occipitomaculata | Redbelly snake          | 1          | 1          | No            |
|                         | Tantilla gracilis                             | Flathead snake          | 1          | 0          | No            |
|                         | Thamnophis proximus proximus                  | Western ribbon snake    | 1          | 1          | No            |
|                         | Thamnophis sirtalis 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          | No            |
| Phrynosomatidae         | Sceloporus undulatus hyacinthus               | Fence lizard            | 1          | 2          | Yes           |
| Scincidae               | Eumeces anthracinus pluvialis                 | Coal skink              | 1          | ?          | No            |
|                         | 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 phaeogaster            | Northern copperhead     | 1          | 2          | Yes           |
|                         | Agkistrodon piscivorus                        | Cottonmouth             | 1          | 0          | No            |
|                         | Crotalus atrox                                | W. diamondback          | 1          | 0          | No            |
|                         | Crotalus horridus                             | Timber rattlesnake      | 1          | 0          | No            |
| Xenodontidae            | Carphophis vermis                             | Western worm snake      | 1          | 2          | Yes           |
| <b>Order Testudines</b> |                                               |                         |            |            |               |
| Chelydridae             | Chelydra serpentina serpentina                | Snapping turtle         | 1          | 2          | Yes           |

Table 5. List of reptiles expected and current status of occurrence at Wilson's Creek NB (cont.).

| <b>Order Testudines</b> | <b>Scientific Name</b>              | <b>Common Name</b>     | <b>Old</b> | <b>New</b> | <b>Trauth</b> |
|-------------------------|-------------------------------------|------------------------|------------|------------|---------------|
| Emydidae                | <i>Chrysemys picta bellii</i>       | Painted turtle         | 1          | 1          | No            |
|                         | <i>Graptemys kohnii</i>             | Mississippi map turtle | 1          | 0          | No            |
|                         | <i>Graptemys geographica</i>        | 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>          | Missouri slider        | 1          | 0          | No            |
|                         | <i>Terrapene carolina triunguis</i> | Three-toed box turtle  | 1          | 2          | Yes           |
|                         | <i>Terrapene ornata ornata</i>      | Ornate box turtle      | 1          | 1          | No            |
|                         | <i>Trachemys scripta elegans</i>    | Red-eared slider       | 1          | 2          | Yes           |
| Kinosternidae           | <i>Sternotherus odoratus</i>        | Musk turtle (stinkpot) | 1          | 0          | No            |
| Trionychidae            | <i>Apalone mutica</i>               | Smooth softshell       | 1          | 0          | No            |
|                         | <i>Apalone spinifera</i>            | Spiny softshell        | 1          | 0          | No            |

Table 6. List of amphibians and reptiles park status, abundance, and residency at Wilson's Creek NB.

| Category  | Order    | Family         | Standard Scientific Name             | Park Status      | Abundance | Residency |
|-----------|----------|----------------|--------------------------------------|------------------|-----------|-----------|
| Amphibian | Anura    | Bufonidae      | Bufo americanus charlesmithi         | Present in Park  | Common    | Resident  |
|           |          |                | Bufo woodhousii fowleri              | Unconfirmed      | Unknown   | Unknown   |
|           |          | Hylidae        | Acris crepitans blanchardi           | Historic         | NA        | NA        |
|           |          |                | Hyla chrysoscelis                    | Present in Park  | Rare      | Resident  |
|           |          |                | Pseudacris crucifer crucifer         | Present in Park  | Common    | Resident  |
|           |          |                | Pseudacris triseriata                | Historic         | NA        | NA        |
|           |          | Microhylidae   | Gastrophryne carolinensis            | Historic         | NA        | NA        |
|           |          | Ranidae        | Rana palustris                       | Present in Park  | Common    | Resident  |
|           |          |                | Rana sphenoccephala                  | Present in Park  | Common    | Resident  |
|           | Caudata  | Plethodontidae | Eurycea longicauda melanopleura      | Present in Park  | Common    | Resident  |
|           |          |                | Eurycea lucifuga                     | Present in Park  | Common    | Resident  |
|           |          |                | Eurycea multiplicata griseogaster    | Probably Present | Unknown   | Unknown   |
|           |          |                | Plethodon albagula                   | Present in Park  | Rare      | Resident  |
|           |          |                | Plethodon angusticlavius             | Probably Present | Unknown   | Unknown   |
|           |          |                | Typhlotriton spelaeus                | Present in Park  | Rare      | Resident  |
|           |          | Proteidae      | Necturus maculosus louisianensis     | Historic         | NA        | NA        |
| Reptile   | Squamata | Anguidae       | Ophisaurus attenuatus attenuatus     | Present in Park  | Uncommon  | Resident  |
|           |          | Colubridae     | Carphophis vermis                    | Present in Park  | Rare      | Resident  |
|           |          |                | Coluber constrictor flaviventris     | Present in Park  | Common    | Resident  |
|           |          |                | Diadophis punctatus arnyi            | Present in Park  | Common    | Resident  |
|           |          |                | Elaphe guttata emoryi                | Probably Present | Unknown   | Unknown   |
|           |          |                | Elaphe obsoleta                      | Present in Park  | Uncommon  | Resident  |
|           |          |                | Heterodon platyrhinos                | Probably Present | Unknown   | Unknown   |
|           |          |                | Lampropeltis calligaster calligaster | Present in Park  | Common    | Resident  |
|           |          |                | Lampropeltis getula holbrooki        | Present in Park  | Common    | Resident  |
|           |          |                | Masticophis flagellum flagellum      | Probably Present | Unknown   | Unknown   |
|           |          |                | Nerodia rhombifera rhombifera        | Probably Present | Unknown   | Unknown   |

Table 6. List of amphibians and reptiles park status, abundance, and residency status at Wilson's Creek NB (cont.).

| Category | Order      | Family          | Standard Scientific Name                          | Park Status      | Abundance | Residency |
|----------|------------|-----------------|---------------------------------------------------|------------------|-----------|-----------|
| Reptile  | Squamata   | Colubridae      | <i>Opheodrys aestivus aestivus</i>                | Present in Park  | Rare      | Resident  |
|          |            |                 | <i>Pituophis catenifer sayi</i>                   | Probably Present | Unknown   | Unknown   |
|          |            |                 | <i>Storeria dekayi</i>                            | Present in Park  | Rare      | Resident  |
|          |            |                 | <i>Storeria occipitomaculata occipitomaculata</i> | Probably Present | Unknown   | Unknown   |
|          |            |                 | <i>Thamnophis proximus proximus</i>               | Probably Present | Unknown   | Unknown   |
|          |            |                 | <i>Thamnophis sirtalis sirtalis</i>               | Present in Park  | Rare      | Resident  |
|          |            |                 | <i>Virginia striatula</i>                         | Probably Present | Unknown   | Unknown   |
|          |            |                 | <i>Virginia valeriae elegans</i>                  | Probably Present | Unknown   | Unknown   |
|          |            | Phrynosomatidae | <i>Sceloporus undulatus hyacinthinus</i>          | Present in Park  | Common    | Resident  |
|          |            | Scincidae       | <i>Eumeces anthracinus pluvialis</i>              | Unconfirmed      | Unknown   | Unknown   |
|          |            |                 | <i>Eumeces fasciatus</i>                          | Present in Park  | Common    | Resident  |
|          |            |                 | <i>Eumeces laticeps</i>                           | Present in Park  | Uncommon  | Resident  |
|          |            |                 | <i>Scincella lateralis</i>                        | Present in Park  | Abundant  | Resident  |
|          |            | Teiidae         | <i>Cnemidophorus sexlineatus viridis</i>          | Present in Park  | Uncommon  | Resident  |
|          |            | Viperidae       | <i>Agkistrodon contortrix phaeogaster</i>         | Present in Park  | Rare      | Resident  |
|          | Testudines | Chelydridae     | <i>Chelydra serpentina serpentina</i>             | Present in Park  | Uncommon  | Resident  |
|          |            | Emydidae        | <i>Chrysemys picta bellii</i>                     | Probably Present | Unknown   | Unknown   |
|          |            |                 | <i>Graptemys geographica</i>                      | Present in Park  | Uncommon  | Resident  |
|          |            |                 | <i>Terrapene carolina triunguis</i>               | Present in Park  | Abundant  | Resident  |
|          |            |                 | <i>Terrapene ornata ornata</i>                    | Probably Present | Unknown   | Unknown   |
|          |            |                 | <i>Trachemys scripta elegans</i>                  | Present in Park  | Uncommon  | Resident  |