



# **Reptile & Amphibian Monitoring at Rocky Springs and Jeff Busby Sites on the Natchez Trace Parkway**

## *Data Summary, Monitoring Year 2012*

Natural Resource Data Series NPS/GULN/NRDS—2013/558



**ON THE COVER**

Cope's gray tree frogs, *Hyla chrysosceles*, at Jeff Busby Site on the Natchez Trace Parkway, 2012  
Photograph by: RL Woodman, Gulf Coast Inventory and Monitoring Network

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## Introduction

The Gulf Coast Inventory and Monitoring Network (GULN) of the National Park Service started implementation of its reptile and amphibian monitoring protocol (GRAMP) at the Rocky Springs (RS) and Jeff Busby (JB) sites on the Natchez Trace Parkway (NATR) in April of 2011. The GRAMP is a protocol developed by GULN in collaboration with Kurt Buhlmann, of the University of Georgia – Savannah River Ecological Laboratory, to provide basic herpetological assemblage monitoring at selected sites on network parks based on peer-reviewed and widely-used standard sampling methods supported by a unified data management and analysis system (Woodman, et al, 2013, in review). This annual report summarizes data collected at the NATR-RS and NATR-JB sites in Monitoring Year (MY) 2012, and includes a summary of the GRAMP, extracts of data collected, and lists of amphibians and reptiles, with count by species, detected in each site in MY2012. The complete RS and JB data tables for MY2012 are provided in Appendix A.

The GULN is located in portions of six states, spanning from Brownsville, Texas, to Pensacola, Florida, and north to Nashville, Tennessee, with main offices located in Lafayette, Louisiana. The network includes eight National Park Service (NPS) units: Big Thicket National Preserve (BITH), Gulf Islands National Seashore (GUIS), Jean Lafitte National Historical Park and Preserve (JELA), Natchez Trace Parkway (NATR), Palo Alto Battlefield National Historical Park (PAAL), Padre Island National Seashore (PAIS), San Antonio Missions National Historical Park (SAAN), and Vicksburg National Military Park (VICK). The network is currently (2013) implementing the GRAMP on six parks (GUIS, JELA, NATR, PAAL, SAAN, and VICK), and is developing park projects on BITH and PAIS for anticipated start-up in FY2014.

NATR is a narrow (typically 100 – 300m wide over most of its length), limited-access scenic parkway extending 444 miles (733 km) northeast from Natchez, Mississippi up to south of Nashville, Tennessee. The parkway crosses 4 ecosystem provinces and a wide range of habitats and ecosystems from the lower Mississippi River bluffs to the Cumberland River Valley and Plateau. Parkway natural resources are mostly fragmented and often consist of small habitat patches, including numerous examples of regrowth forest communities, “old field” successional communities in abandoned agricultural fields, and relict tree plantations. In addition, many short reaches of wetlands, streams, and small rivers are crossed by the Trace. The parkway is bordered on both sides by agricultural landscapes, together with large urban areas such as Jackson and Tupelo, MS. A small number of areas within the Mississippi portion of NATR, including the Rocky Springs (RS) and Jeff Busby (JB) sites used in this monitoring project, exist as enlarged areas which offer visitors expanded natural resource and historical sites, services, and campgrounds (Figure 1). From the natural resource perspective, these enlarged areas are more likely to host substantial examples of the herpetofauna of Mississippi, and these areas offer park management better opportunity to shelter faunal populations within the larger region crossed by the park.

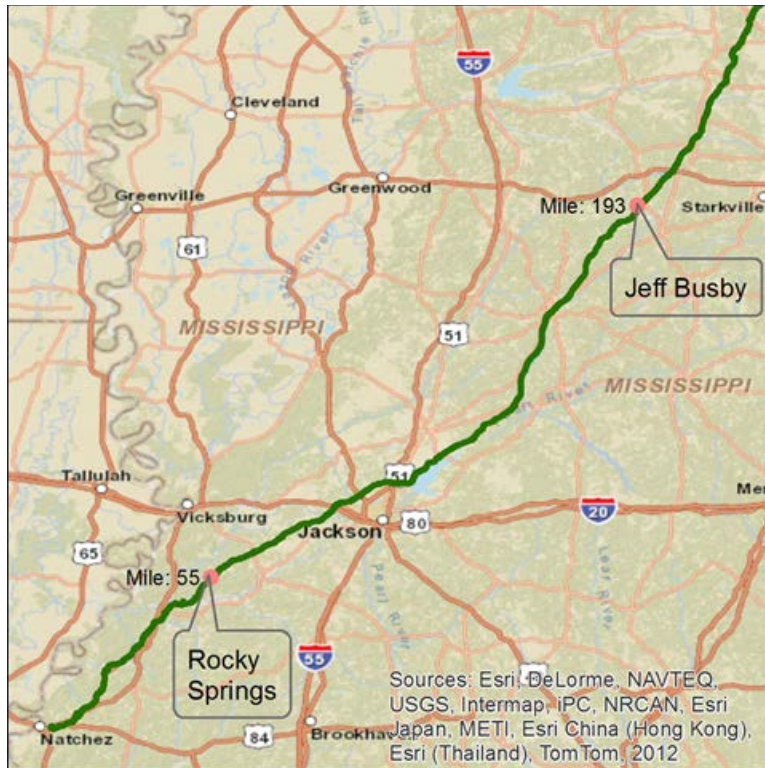


Figure 1. Map of the Mississippi portion of NATR showing the locations of Rocky Springs and Jeff Busby areas. The indicated mile numbers correspond to the NATR mile-post closest to each area.

Amphibians were identified as a network higher-priority vital sign during initial vital signs selection performed in 2004. Amphibians were combined with reptiles when the GULN Monitoring Plan (Segura et al, 2007) was finalized, as it was broadly accepted that sampling for many amphibians is equally effective for coexisting reptiles. Amphibians and reptiles (herps) are ranked highly among potential vital signs for GULN because herps 1) are a diverse fauna associated with many habitats on all GULN parks, 2) specific species come under legal mandates related to state – level protected status, and 3), herps constitute a diverse set of potential indicators of local and regional changes in ecosystems, due to their widely-demonstrated sensitivities to many anthropogenic system inputs and actions (pollutants and habitat disruption and fragmentation). In addition, herps have collectively become the subject of ever-growing conservationist and resource-management concern given the increasing recognition of their widespread decline at scales ranging from the local to global.

This monitoring project addresses terrestrial and arboreal herp assemblages in RS and JB sites. These sites were selected for monitoring based on a combination of patch size, site access for sampling crew, site security, desire to distribute monitoring effort into multiple regions and ecosystems on the park, and consideration of park management interests. The RS site, located in the Port Gibson Ranger District at mile post 55, comprises 265 hectares of mixed hardwood forest surrounding the historic Rocky Spring and its associated small ephemeral stream drainage. The JB site is located in the Kosciusko Ranger District at mile post 193, and comprises 101 hectares of mixed forest habitats dominated by Little Mountain, a regional high point and among the higher elevations in Mississippi.

JB habitats range from a hill-top pine – oak mix down to a longleaf pine flat at the hill base. Deep stream cuts provide shaded mixed-hardwood dominated riparian corridors.

One species of focal interest to park management, Webster’s Salamander (*Plethodon websteri*), is likely to be detected at one or both sampling areas. This species is considered imperiled in MS largely due to its limited and disjunct distribution in the state. Monitoring herps in parks will contribute to both park-level resource knowledge and improved management, and provide insight into habitat and ecosystem change. Monitoring is designed to provide data comparable to that obtained by other research and inventory efforts and will potentially contribute to regional and national data-sets that further our understanding of population and community trends at many scales.

This annual report provides an overview of methodology and implementation of monthly sampling across the monitoring year. Results presented here are limited to descriptive summaries of the annual findings and data about observed species and abundance presented at a monthly sampling scale. Additional analyses and synthesis reports will be completed every 4 – 5 years beginning in 2015, to include assessment of potential trends in species-count, changes in relative abundance, and changes in measurable assemblage composition and structure. Faunal trends will be evaluated in the context of recorded environmental data and with consideration of noted events, such as rainfall and significant anthropogenic and other impacts to local resources.

# Methods

## Sampling Design

Herp monitoring at NATR RS and JB sites utilizes terrestrial cover-board (CB) and arboreal PVC-pipe (PVC) fixed-point sampling methods coupled with environmental conditional monitoring. RS is sampled using 2 split linear CB arrays (clusters) distributed in the forested areas adjacent to the park area maintenance building and along the riparian corridor and stream-bed close to the historic Rocky Spring. One PVC cluster is collocated over 1 CB cluster in the riparian area to simultaneously assess terrestrial and arboreal species within the selected sampling space (Figure 2). The JB site is sampled using 2 split linear CB clusters distributed in wooded areas distributed from the hill summit down to the pine flat at the hill base adjacent to the area maintenance building access. PVC clusters are collocated with the hill-top and riparian area CB clusters (Figure 3).

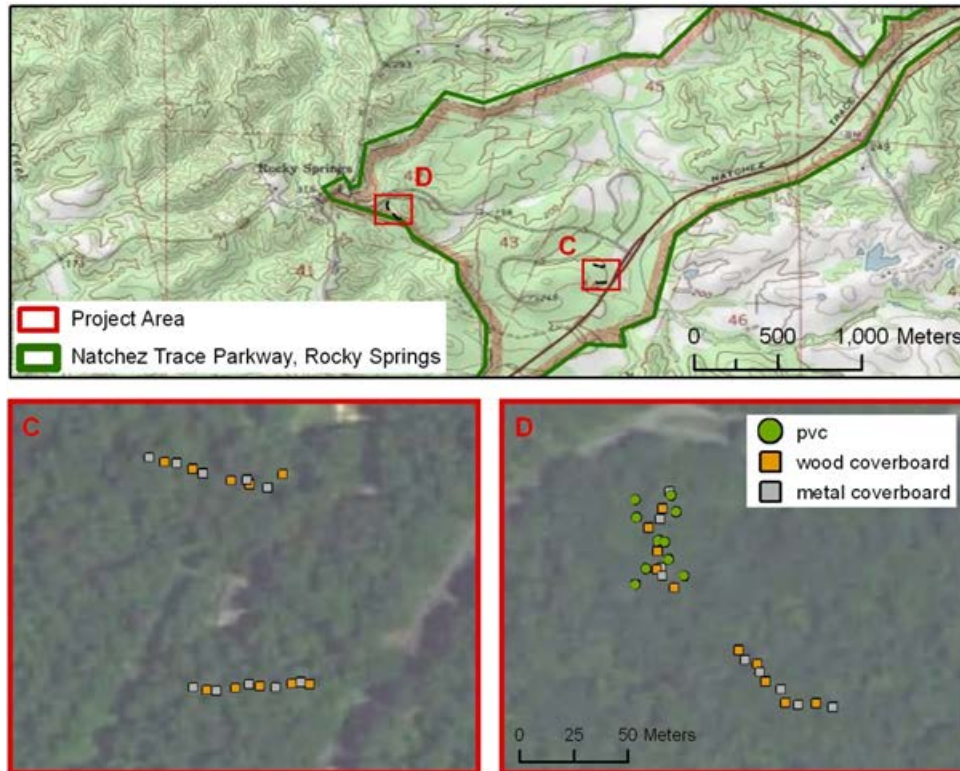


Figure 2. Map of the NATR-RS site and project sampling arrays. The two lower frames (C and D) depict the CB and PVC sampler distributions in RS arrays.

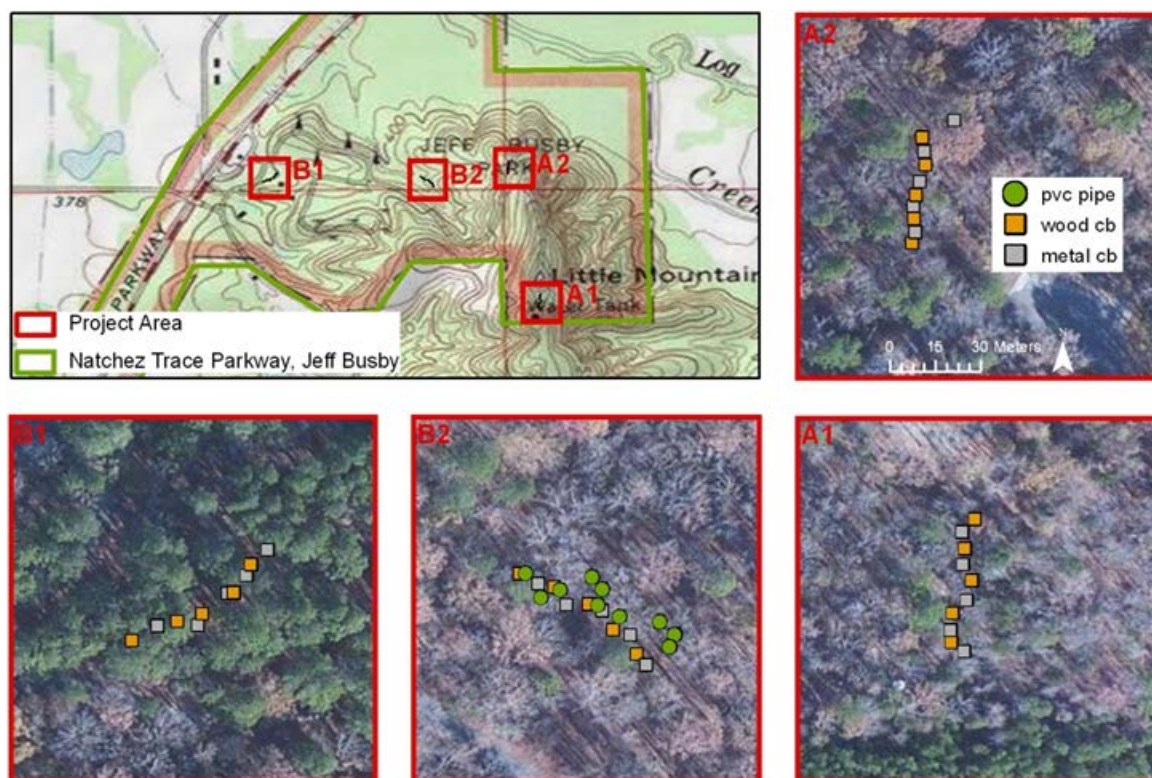


Figure 3: Map of the NATR-JB site and project sampling arrays. The four smaller frames (A1, A2, B1 and B2) depict the CB and PVC sampler distributions in JB arrays.

The spatial distribution of CB and PVC constitute fixed multiple-array sampling designs in each sampling area, where each cluster is statistically independent of and does not share possible specimens with any other cluster. Initial locations of each linear CB and PVC array start-point were selected by randomizing from among five available possible start-points in each area, followed by placing CB panels at circa 5m spacing in a line extending along the prevailing ground feature in the site. Each split CB array consists of two sets of ten permanently-sited 3 x 4 US foot panels (five roofing tin, and five  $\frac{3}{4}$  inch plywood). Each co-located PVC cluster consists of 10 pairs of PVC pipes attached to trees located within the CB cluster area. Each PVC pair consists of one 1 inch x 2 foot pipe and one 2 inch x 2 foot pipe. Individual device locations are determined by natural micro-habitat and site availability (spaces suitable for CB panels, trees large enough to host pipe pairs). All CB and PVC locations are mapped onto the project GIS layers and database using GPS location data. No baits, lures, added food or chemical attractants are used in any sampling at NATR sites.

Total sampling effort at NATR-RS consists of 4 CB clusters (a total of 40 panels) and 1 PVC cluster (a total of 10 pipe-pairs). Total sampling effort at NATR-JB consists of 4 CB clusters (a total of 40 panels) and 2 PVC clusters (a total of 20 pipe pairs).

In addition to CB and PVC sampling, field crew record all individuals seen outside of sampling devices during sampling activities. These encounters are logged as “casual observations” (Cas. Obs.) and contribute to composite data on species-richness and species-specific population descriptive

parameters, such as mean size and sex-ratio estimation in the population, but are not considered in analyses utilizing device as a factor.

One data-logger (HoBo pro V2, by Onset, Inc.) is deployed at a PVC cluster in each sampling area (RS and JB) to provide long-term air-temperature and relative humidity monitoring at 10-minute intervals throughout the monitoring year.

### **Sampling and Data-Collection**

Sampling emphasizes consistent collection of detailed, high quality data on all encountered specimens to provide a reliable dataset for assessing assemblage composition and structure. CB, PVC, and Casual Observations all yield hand-specimens and photographic records.

All field crew are led by experienced field biologists with detailed familiarity with the taxonomy of regional herpetofauna. Performance of sampling events follows the methodology and procedures prescribed for each sampling method in GRAMP protocol SOP (Woodman, et al 2013, in review). All specimens are hand-collected where possible for detailed assessment. Data include location, time, species ID (when possible), body length and sex (when possible), and count, when multiple individuals of a type are observed but not all are handled and assessed.

Specimen information is recorded on paper field data sheets during sampling. Photographs are taken of collected specimens to support post-sampling taxonomic ID review. Specimens are handled with appropriate prophylaxis and technique as adapted from the ASIH Guidelines (Beaupre 2004) and specified in the GRAMP. All collected specimens are immediately released following processing at the collection point or site. Non-collected individuals (venomous snakes are never handled, other individuals may escape or avoid capture) are photo-documented during sampling procedures, and images provide confirmation of “no-catch” encounters for data records.

### **Monitoring Schedule**

NATR-RS and JB sites are sampled every month over each Monitoring Year (MY, defined as being from October 01 to September 30), for a total of 12 monthly sampling visits per MY. Each visit consists of 1 work-day per site (RS and JB): The sampling team sequentially samples CB and PVC clusters within the site starting with a safety briefing at ca 0730 and typically completing CB and PVC sampling by 1030. The array sampling order is held constant over all visits to avoid random variation in yield which could result from time-of-day effects. All CB and PVC sampling are completed as early in a day as possible so as to reduce impacts on yield from increasing air and ground temperatures.

### **Data Management**

Data are recorded in the field on standard GULN paper field data sheets. Field crews submit completed data sheets to the GULN Data Manager and the GULN GRAMP Project Leader for review and verification of taxonomic information. All data are entered into the GRAMP database following procedures specified in SOP 5 Data Entry of the GRAMP protocol (Woodman, et al, 2013, in review). Project data are managed following procedures and standards specified in the GULN

Data Management Plan (Granger, 2007). Data are extracted from this database for analysis and reporting. The complete Monitoring Year 2012 faunal data are provided in Appendix A of this report. Data are also made available by going to the GULN Amphibian & Reptile Monitoring Project in the NPS Integrated Resource Management Applications (IRMA) portal at: <https://irma.nps.gov/App/Reference/Profile/2192506>.

## Results

The complete NATR-JB and RS Project datasets are provided in Appendix A of this report. The Project Data Tables list observation date, sampling location, sampling method, common and scientific name, and body length and sex (if determined) for each individual recorded. Key aspects of this dataset are summarized in the following tables and graphs by sampling site. All summary data are presented in a per-sampling-event format with cumulative totals for the MY where appropriate.

### NATR-RS Site:

Sampling at the NATR-RS site yielded a total of 88 individuals (31 amphibians, 57 reptiles) representing 14 species (5 amphibians, 9 reptiles) from all methods in MY2012. The two most abundant amphibians were Fowler's Toad (*Anaxyrus fowleri*, 12) and Mississippi Slimy Salamander (*Plethodon mississippi*, 10), accounting for 71% of all amphibians observed. The two most abundant reptiles were Common Ground Skink (*Scincella lateralis*, 44), and Green Anole (*Anolis carolinensis*, 5), accounting for 86% of reptiles observed.

Tables 1 and 2 present the summary counts of individual amphibians and reptiles, respectively, observed by sampling method (CB = cover-boards, PVC = PVC-pipes, Cas Obs = Casual Observations) by sampling month at NATR-RS in MY2012.

Table 1: NATR-RS Amphibians:

| Sampling Method         | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total By Method |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| CB                      | 2        | 2        | 2        | 3        | 1        | 6        | 1        | 3        | 2        | 1        | 1        | 1        | 25              |
| PVC                     | 0        | 1        | 0        | 1        | 0        | 1        | 0        | 0        | 0        | 0        | 1        | 0        | 4               |
| Cas Obs                 | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 2        | 0        | 0        | 0        | 2               |
|                         |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| <b>Total n by Event</b> | <b>2</b> | <b>3</b> | <b>2</b> | <b>4</b> | <b>1</b> | <b>7</b> | <b>1</b> | <b>3</b> | <b>4</b> | <b>1</b> | <b>2</b> | <b>1</b> | <b>31</b>       |

Table 2. NATR-RS reptiles:

| Sampling Method         | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012  | JUL 2012 | AUG 2012 | SEP 2012 | Total By Method |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|----------|-----------------|
| CB                      | 4        | 5        | 0        | 1        | 2        | 6        | 1        | 5        | 7         | 8        | 5        | 5        | 49              |
| PVC                     | 1        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0         | 0        | 0        | 0        | 1               |
| Cas Obs                 | 0        | 2        | 0        | 0        | 0        | 0        | 0        | 1        | 3         | 0        | 0        | 1        | 7               |
|                         |          |          |          |          |          |          |          |          |           |          |          |          |                 |
| <b>Total n by Event</b> | <b>5</b> | <b>7</b> | <b>0</b> | <b>1</b> | <b>2</b> | <b>6</b> | <b>1</b> | <b>6</b> | <b>10</b> | <b>8</b> | <b>5</b> | <b>6</b> | <b>57</b>       |

The total numbers of individual reptiles and amphibians observed at NATR-RS across all methods varied among sampling events, with reptiles showing modestly larger abundance than did amphibians in 8 of 12 events, and greater abundance later in the MY (Figure 4).

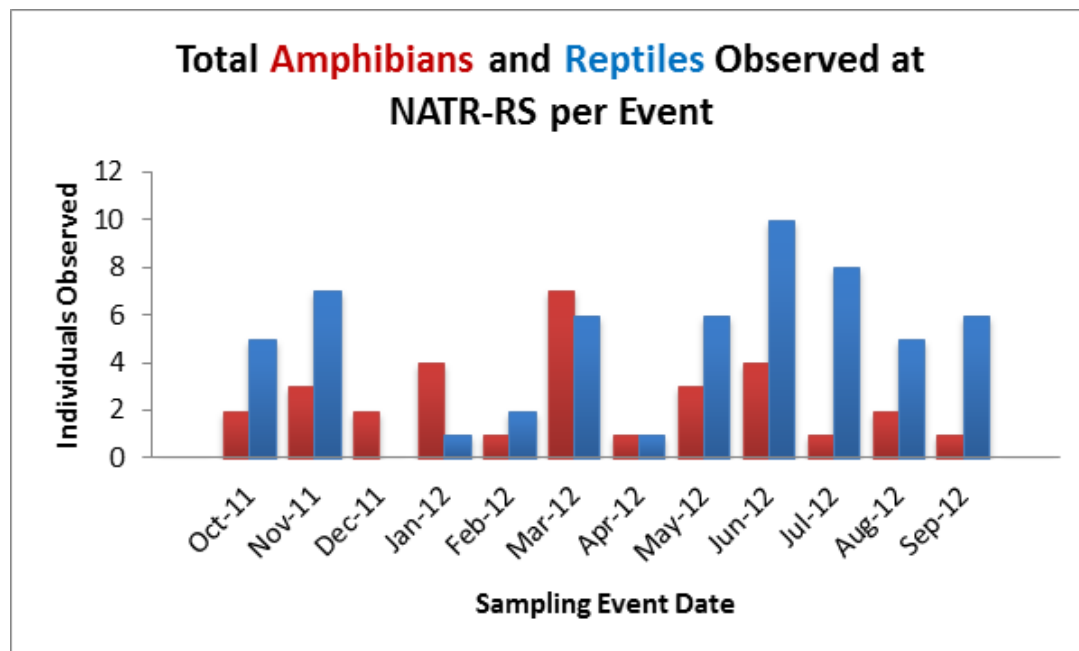


Figure 4: Total count of amphibians and reptiles observed at NATR-RS over all methods by sampling event in MY2012.

**Numbers of amphibian and reptile species observed at NATR-RS in MY2012:**

Tables 3 and 4 present the counts of amphibian and reptile species, respectively, observed by sampling method (CB = cover-boards, PVC = PVC-pipes, Cas Obs = Casual Observations) by sampling month at NATR-RS in MY2012. It should be noted that some species were observed in more than 1 sampling method in some events. The total count column presents the counts of all species of the class observed by method over the year. The yellow block reports the sum of all species of the class for all methods for the year.

Table 3: Number of amphibian species seen at NATR-RS in MY2012.

| Sampling Method               | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total Spp. |
|-------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|
| CB                            | 2        | 2        | 2        | 2        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 4          |
| PVC                           | 0        | 1        | 0        | 1        | 0        | 1        | 0        | 0        | 0        | 0        | 1        | 0        | 1          |
| Cas Obs                       | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 1        | 0        | 0        | 0        | 1          |
| <b>Total species by Event</b> | <b>2</b> | <b>3</b> | <b>2</b> | <b>3</b> | <b>1</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>1</b> | <b>5</b>   |

Table 4: Number of reptile species seen at NATR-RS in MY2012.

| Sampling Method               | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total Spp. |
|-------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|
| CB                            | 1        | 1        | 0        | 1        | 1        | 3        | 1        | 2        | 3        | 2        | 1        | 1        | 7          |
| PVC                           | 1        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 1          |
| Cas Obs                       | 0        | 1        | 0        | 0        | 0        | 0        | 0        | 1        | 2        | 0        | 0        | 1        | 3          |
|                               |          |          |          |          |          |          |          |          |          |          |          |          |            |
| <b>Total species by Event</b> | <b>2</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>1</b> | <b>3</b> | <b>1</b> | <b>2</b> | <b>4</b> | <b>2</b> | <b>1</b> | <b>2</b> | <b>9</b>   |

NATR-RS yielded only small numbers of species in most events during MY2012; there were generally only 1 – 4 species of all types observed in most events, and events varied widely as to how many species of each class were observed (Figure 5).

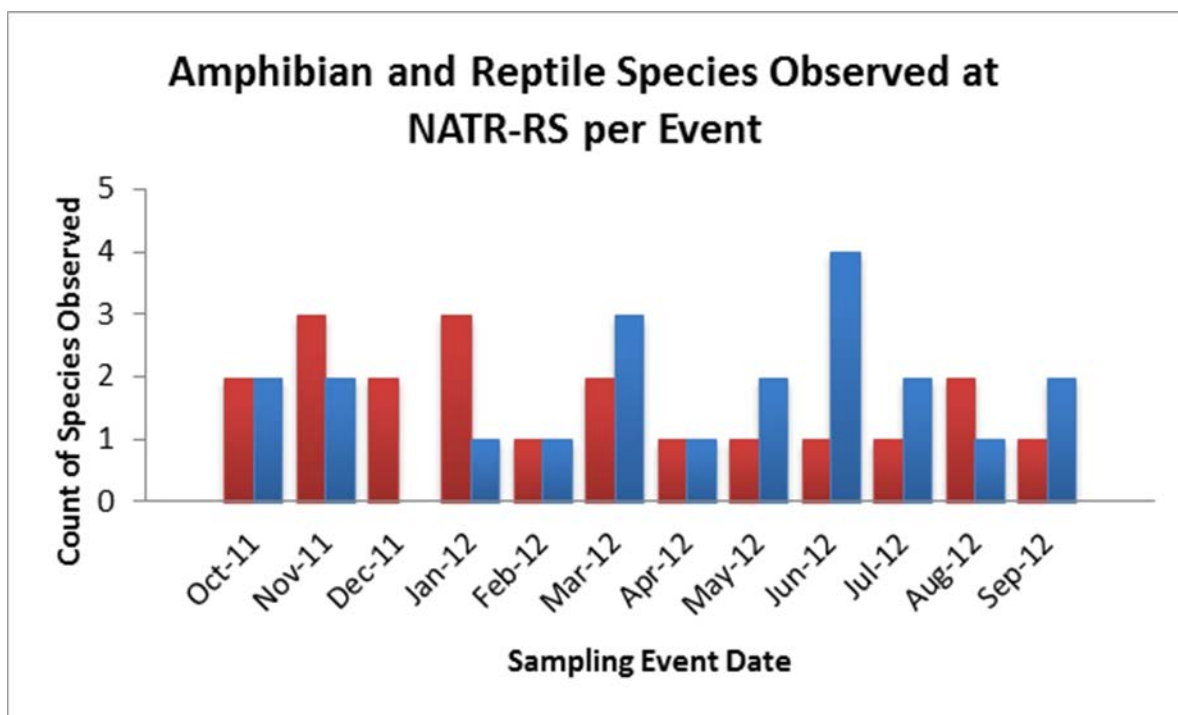


Figure 5: Numbers of amphibian and reptile species observed in each NATR-RS sampling event in MY2012.

***The accumulation of species-detections over time at NATR-RS:***

Species-accumulations at NATR-RS ended prior to the conclusion of MY2012; amphibian accumulation ended as of JAN 2012, while reptile accumulation plateaued with the JUL 2012 event (Table 5 and visualized in Figure 6).

Table 5: Cumulative species-counts for amphibians, reptiles, and all herp species at NATR-RS over MY2012. The high-lighted counts in the SEP 2012 column are the cumulative totals for the MY.

| Taxon Group             | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Amphibians              | 2        | 3        | 4        | 5        | 5        | 5        | 5        | 5        | 5        | 5        | 5        | 5        |
| Reptiles                | 2        | 2        | 2        | 3        | 3        | 4        | 5        | 5        | 8        | 9        | 9        | 9        |
| Cum of all Herp Species | 4        | 5        | 6        | 8        | 8        | 9        | 10       | 10       | 13       | 14       | 14       | 14       |

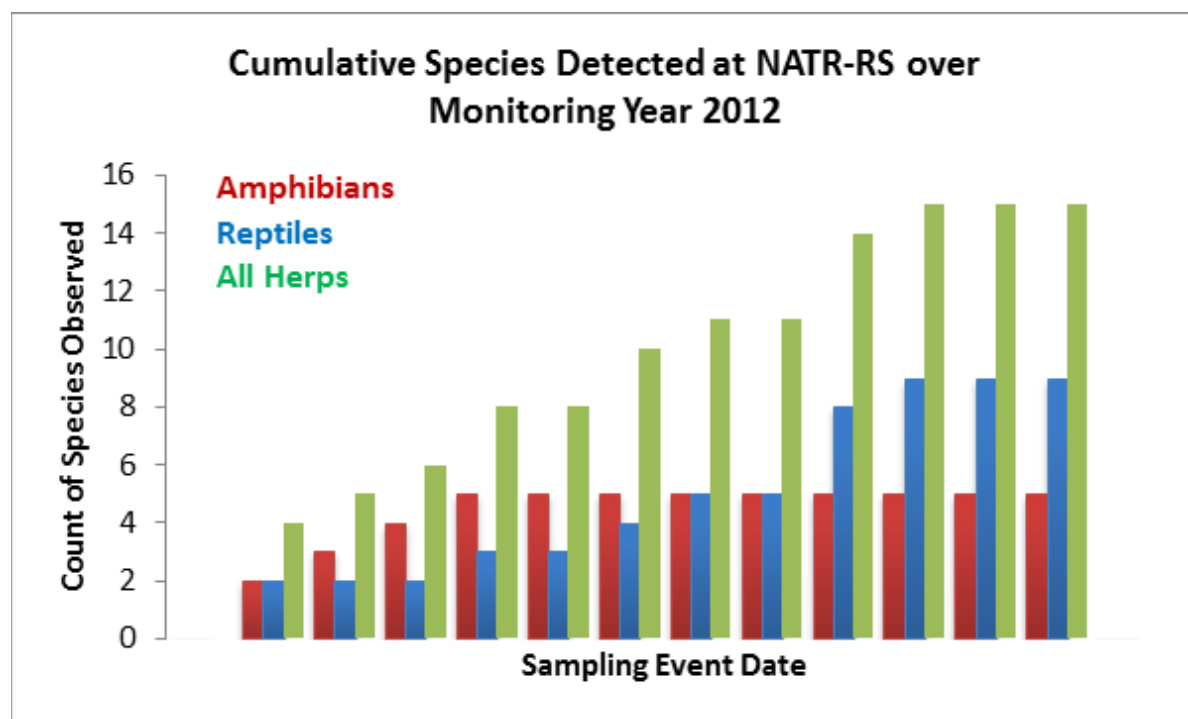


Figure 6: Cumulative count of amphibian, reptile, and “all herps” species observed at NATR-RS over MY2012. Notably, “new species” detections plateaued for both classes well before the MY completed. This suggests that all species which were reasonably abundant in the area and susceptible to detection by these methods have been detected.

The amphibian and reptile species detected at NATR-RS in MY2012 sampling are listed in Table 6, below.

Table 6: Amphibian and Reptile species observed at NATR-RS in MY2012.

| Amphibians                   |                              |    | Reptiles                                |                       |    |
|------------------------------|------------------------------|----|-----------------------------------------|-----------------------|----|
| Scientific Name:             | Common Name:                 |    | Scientific Name:                        | Common Name:          |    |
| <i>Ambystoma opacum</i>      | Marbled Salamander           | 2  | <i>Agkistrodon contortrix</i>           | Copperhead            | 1  |
| <i>Anaxyrus fowleri</i>      | Fowler's Toad                | 12 | <i>Anolis carolinensis</i>              | Green Anole           | 4  |
| <i>Hyla chrysoscelis</i>     | Cope's Gray Tree Frog        | 4  | <i>Carphophis amoenus</i>               | Midwestern Worm-snake | 1  |
| <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 10 | <i>Diadophis punctatus</i>              | Ring-neck Snake       | 1  |
| <i>Plethodon websteri</i>    | Webster's Salamander         | 3  | <i>Elaphe guttata</i>                   | Corn Snake            | 2  |
|                              |                              |    | <i>Lampropeltis getula</i>              | Speckled King Snake   | 2  |
|                              |                              |    | <i>Scincella lateralis</i>              | Ground Skink          | 44 |
|                              |                              |    | <i>Terrapene carolinensis triunguis</i> | Common Box Turtle     | 1  |
|                              |                              |    | <i>Thamnophis sirtalis</i>              | Common Garter Snake   | 1  |

**Air temperature and percent-relative humidity recorded at NATR-RS during MY2012:**

Air temperature and %-RH were recorded at 10-minute intervals throughout MY2012 using HoBo data-loggers placed in the RS riparian corridor sampling location to provide an environmental condition covariate to faunal data. Air-T and %-RH are presented as data-value traces over the MY2012 period in Figure 7 below. Note that these data traces include data for approximately 30 days prior to start of MY2012 sampling (Oct 04, 2011), in recognition that potential impacts from changing air-T and %-RH may take several weeks to affect faunal behavior and manifest in detection rates.

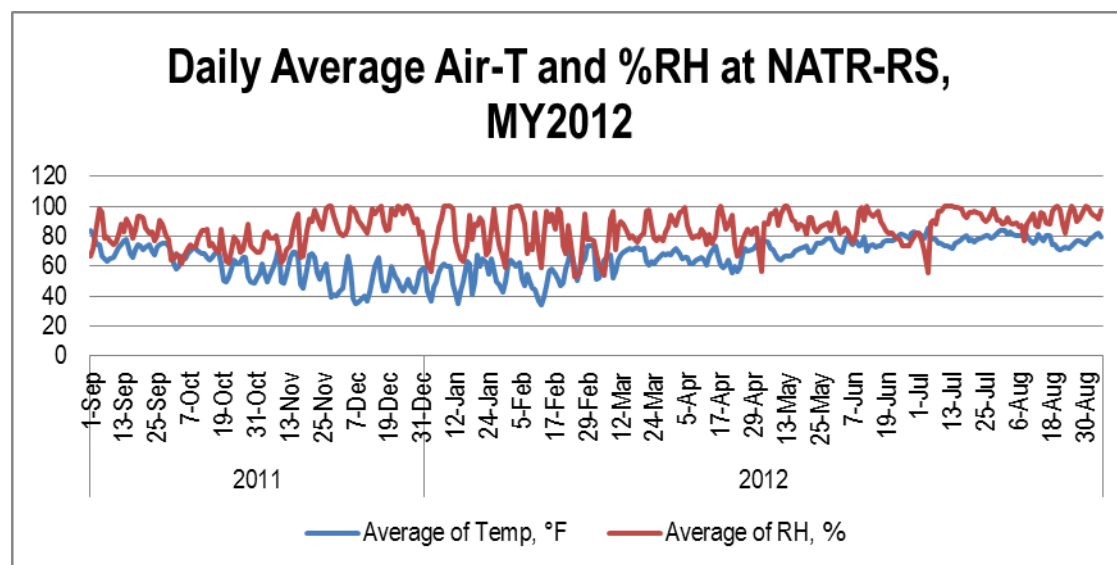


Figure 7. Monthly mean air temperature and percent-relative humidity recorded at NATR-RS riparian area from SEP 01 2011 through SEP 02 2012.

**NATR-JB Site:**

Sampling at the NATR-JB site yielded a total of 83 individuals (46 amphibians, 37 reptiles) representing 17 species (8 amphibians, 9 reptiles) from all methods in Monitoring Year 2012. The two most abundant amphibians were Cope's Gray Tree Frog (*Hyla chrysosceles*, 20) and Mississippi Slimy Salamander (*Plethodon mississippi*, 15), accounting for 76% of all amphibians observed. The two most abundant reptiles were Common Ground Skink (*Scincella lateralis*, 19) and 5-lined Skink (*Eumeces fasciatus*, 7), accounting for 70% of reptiles observed.

**Numbers of individual amphibians and reptiles observed at NATR-JB in MY2012:**

Tables 7 and 8 present the summary counts of individual amphibians and reptiles, respectively, observed by sampling method (CB = cover-boards, PVC = PVC-pipes, Cas Obs = Casual Observations) by sampling month at NATR-JB in MY2012.

Table 7: NATR-JB Amphibians:

| Sampling Method         | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total By Method |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| CB                      | 0        | 5        | 2        | 1        | 3        | 3        | 2        | 2        | 0        | 1        | 1        | 2        | 22              |
| PVC                     | 1        | 0        | 0        | 0        | 0        | 3        | 0        | 2        | 5        | 1        | 4        | 4        | 20              |
| Cas Obs                 | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 4        | 0        | 0        | 0        | 4               |
|                         |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| <b>Total n by Event</b> | <b>1</b> | <b>5</b> | <b>2</b> | <b>1</b> | <b>3</b> | <b>6</b> | <b>2</b> | <b>4</b> | <b>9</b> | <b>2</b> | <b>5</b> | <b>6</b> | <b>46</b>       |

Table 8: NATR-JB Reptiles:

| Sampling Method         | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total By Method |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| CB                      | 2        | 5        | 0        | 0        | 0        | 2        | 3        | 2        | 1        | 4        | 6        | 7        | 32              |
| PVC                     | 0        | 0        | 0        | 0        | 0        | 3        | 0        | 0        | 0        | 0        | 0        | 1        | 4               |
| Cas Obs                 | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 1        | 0        | 0        | 0        | 1               |
|                         |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| <b>Total n by Event</b> | <b>2</b> | <b>5</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>5</b> | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>6</b> | <b>8</b> | <b>37</b>       |

The total numbers of individual reptiles and amphibians observed at NATR-JB across all methods varied among sampling events across the MY (Figure 8).

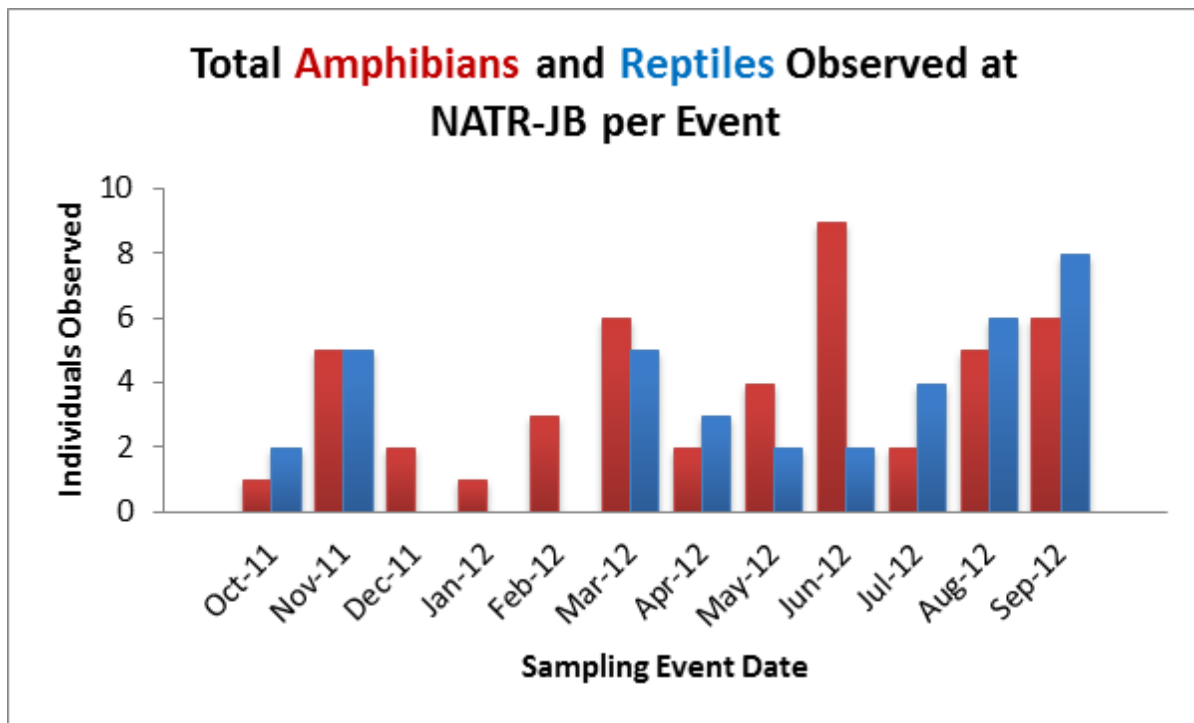


Figure 8: Total count of amphibians and reptiles observed at NATR-JB over all methods by sampling event in MY2012.

***Numbers of amphibian and reptile species observed at NATR-JB in MY2012:***

Tables 9 and 10 present the counts of amphibian and reptile species, respectively, observed by sampling method (CB = cover-boards, PVC = PVC-pipes, Cas Obs = Casual Observations) by sampling month at NATR-JB in MY2012. It should be noted that some species were observed in more than 1 sampling method in some events. The total count column presents the counts of all species of the class observed by method over the year. The yellow block reports the sum of all species of the class for all methods for the MY.

Table 9: Number of amphibian species seen at NATR-JB in MY2012.

| Sampling Method               | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total Spp. |
|-------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|
| CB                            | 0        | 1        | 1        | 1        | 1        | 1        | 2        | 2        | 0        | 1        | 1        | 2        | 5          |
| PVC                           | 1        | 0        | 0        | 0        | 0        | 1        | 0        | 1        | 1        | 1        | 1        | 1        | 1          |
| Cas Obs                       | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 2        | 0        | 0        | 0        | 2          |
| <b>Total species by Event</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>2</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>2</b> | <b>3</b> | <b>8</b>   |

Table 10: Number of reptile species seen at NATR-JB in MY2012.

| Sampling Method               | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 | Total Spp. |
|-------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|
| CB                            | 2        | 2        | 0        | 0        | 0        | 2        | 3        | 2        | 1        | 4        | 3        | 1        | 8          |
| PVC                           | 0        | 0        | 0        | 0        | 0        | 1        | 0        | 0        | 0        | 0        | 0        | 1        | 1          |
| Cas Obs                       | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 1        | 0        | 0        | 1        | 1          |
|                               |          |          |          |          |          |          |          |          |          |          |          |          |            |
| <b>Total species by Event</b> | <b>2</b> | <b>2</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> | <b>1</b> | <b>2</b> | <b>4</b> | <b>2</b> | <b>2</b> | <b>9</b>   |

The numbers of amphibian and reptile species observed at NATR-JB both varied widely by event over MY2012, and there were only 1 – 4 herp species observed in any event (Figure 9).

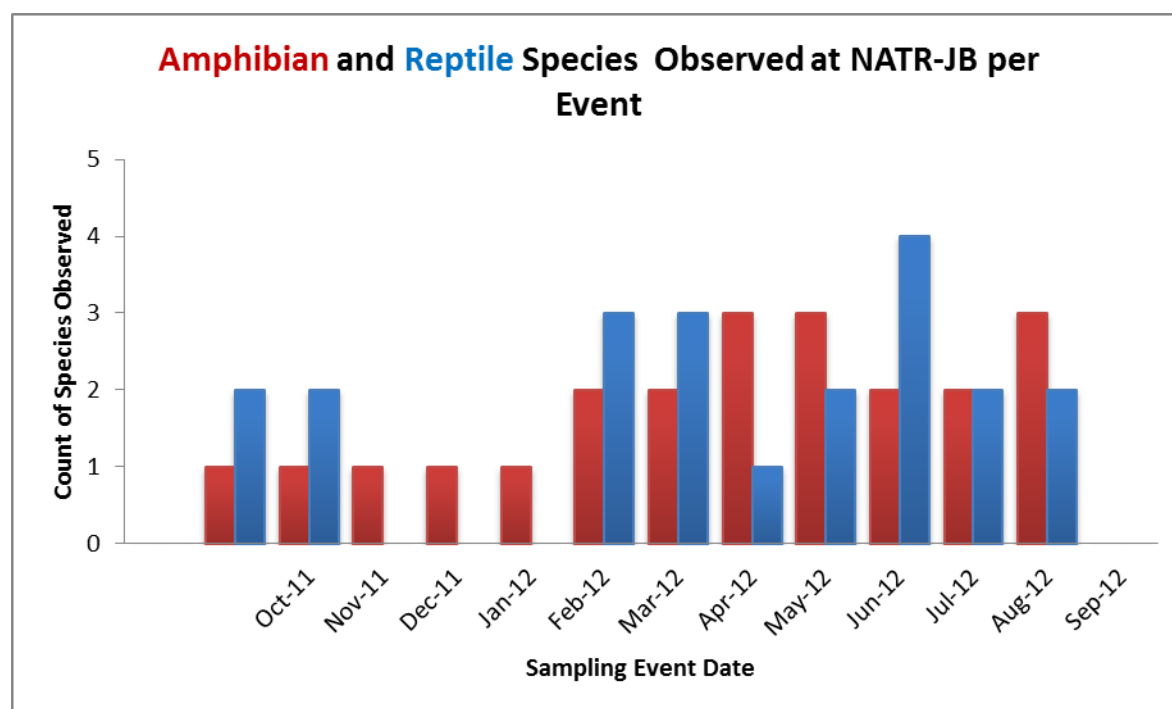


Figure 9: Numbers of amphibian and reptile species observed in each NATR-JB sampling event in MY2012.

***The accumulation of species detections over time at NATR-JB:***

Amphibian species accumulated throughout the monitoring year, while reptile accumulation plateaued as of July, 2012 (Table 11, and visualized in Figure 10). These results suggest that the reptiles likely to be detected by our sampling methods in the JB area have been detected, and that few or no additional species are likely to be accumulated in the near future. On the other hand, additional amphibians may be reasonable, given their continued accumulation to the end of MY2012.

Table 11: Cumulative species-counts for amphibians, reptiles, and all herp species at NATR-JB over MY2012. The high-lighted counts in the SEP 2012 event are the cumulative totals for the MY.

| Taxon Group             | OCT 2011 | NOV 2011 | DEC 2011 | JAN 2012 | FEB 2012 | MAR 2012 | APR 2012 | MAY 2012 | JUN 2012 | JUL 2012 | AUG 2012 | SEP 2012 |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Amphibians              | 1        | 2        | 2        | 2        | 2        | 2        | 3        | 4        | 6        | 7        | 7        | 8        |
| Reptiles                | 2        | 3        | 3        | 3        | 3        | 5        | 7        | 7        | 7        | 9        | 9        | 9        |
| Cum of all Herp Species | 3        | 5        | 5        | 5        | 5        | 7        | 10       | 11       | 13       | 16       | 16       | 17       |

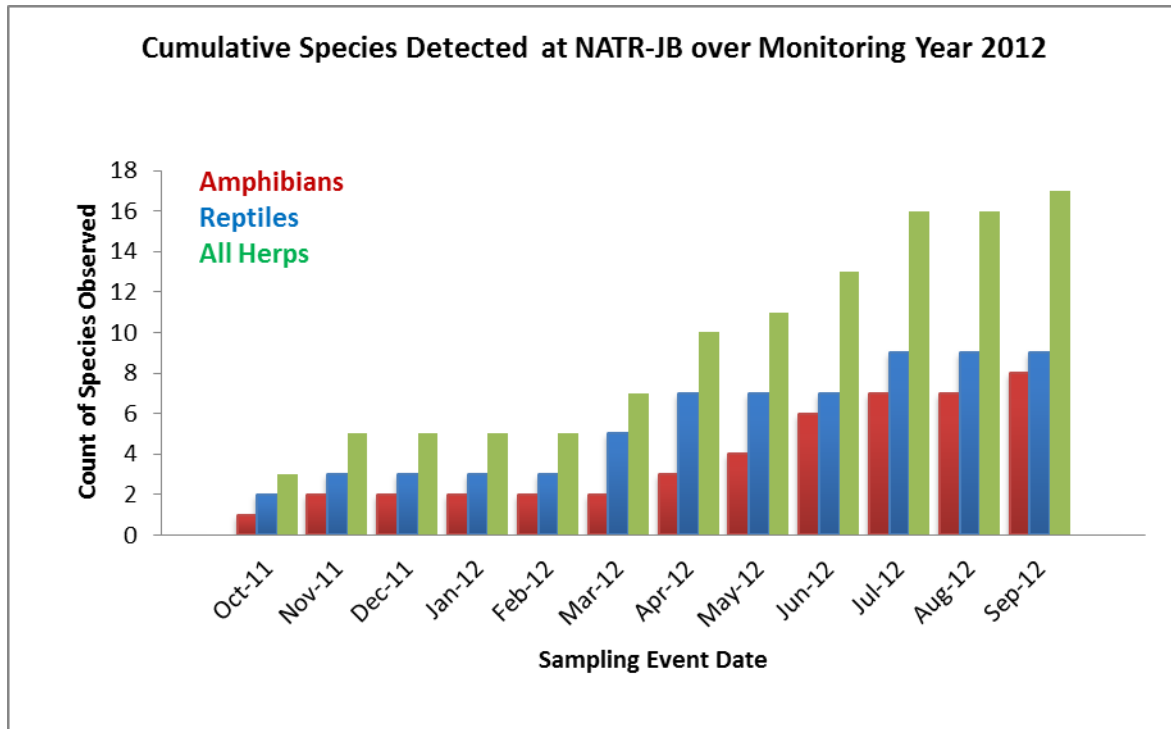


Figure 10: Cumulative count of amphibian, reptile, and “all herps” species observed at NATR-JB over MY2012. Notably, “new amphibian species” continued to be detected list throughout the year, while reptile species-accumulation plateaued from July, 2012. This likely reflects some combination of species being rare in the sampling site, species exhibit seasonality of possible detection, and sampling methods are limited and biased as to which species may be efficiently detected.

The amphibian and reptile species detected at NATR-JB site in MY2012 sampling are listed in Table 12 below.

Table 12: Amphibian and Reptile species observed at NATR-JB in MY2012.

| <b>Amphibians</b>                |                              |    | <b>Reptiles</b>             |                      |    |
|----------------------------------|------------------------------|----|-----------------------------|----------------------|----|
| <b>Scientific Name:</b>          | <b>Common Name:</b>          |    | <b>Scientific Name:</b>     | <b>Common Name:</b>  |    |
| <i>Ambystoma opacum</i>          | Marbled Salamander           | 2  | <i>Anolis carolinensis</i>  | Green Anole          | 5  |
| <i>Anaxyrus fowleri</i>          | Fowler's Toad                | 1  | <i>Carphophis amoenus</i>   | Midwestrn Worm-snake | 1  |
| <i>Eurycea guttolineata</i>      | Three-lined salamander       | 2  | <i>Coluber constrictor</i>  | Eastern Racer        | 1  |
| <i>Gastrophryne carolinensis</i> | Eastern Narrow-mouth Toad    | 3  | <i>Diadophis punctatus</i>  | Ring-neck Snake      | 1  |
| <i>Hyla chrysoscelis</i>         | Cope's Gray Tree Frog        | 20 | <i>Eumeces fasciatus</i>    | Five-lined Skink     | 7  |
| <i>Lithobates sphenoccephala</i> | Southern Leopard Frog        | 2  | <i>Eumeces laticeps</i>     | Broad-head Skink     | 1  |
| <i>Plethodon mississippi</i>     | Mississippi Slimy Salamander | 15 | <i>Lampropeltis getula</i>  | Speckled King Snake  | 1  |
| <i>Pseudacris crucifer</i>       | Spring Peeper                | 1  | <i>Sceloporus undulatus</i> | Eastern Fence Lizard | 1  |
|                                  |                              |    | <i>Scincella lateralis</i>  | Ground Skink         | 19 |

***Air temperature and percent-relative humidity recorded at NATR-JB during MY2012:***

Air temperature and %-RH were recorded at 10-minute intervals throughout MY2012 using HoBo data-loggers placed in the NATR-JB riparian-corridor sampling area to provide an environmental condition covariate to faunal data. Air-T and %-RH are presented as data-value traces over the MY2012 period in Figure 11 below. Note that these data traces include data for approximately 30 days prior to start of MY2012 sampling, in recognition that potential impacts from changing air-T and %-RH may take several weeks to affect faunal behavior and manifest in detection rates. Formal assessment of possible relationships between environmental conditions and faunal parameters is an anticipated element in long-term trend analysis to be performed from 2015 on.

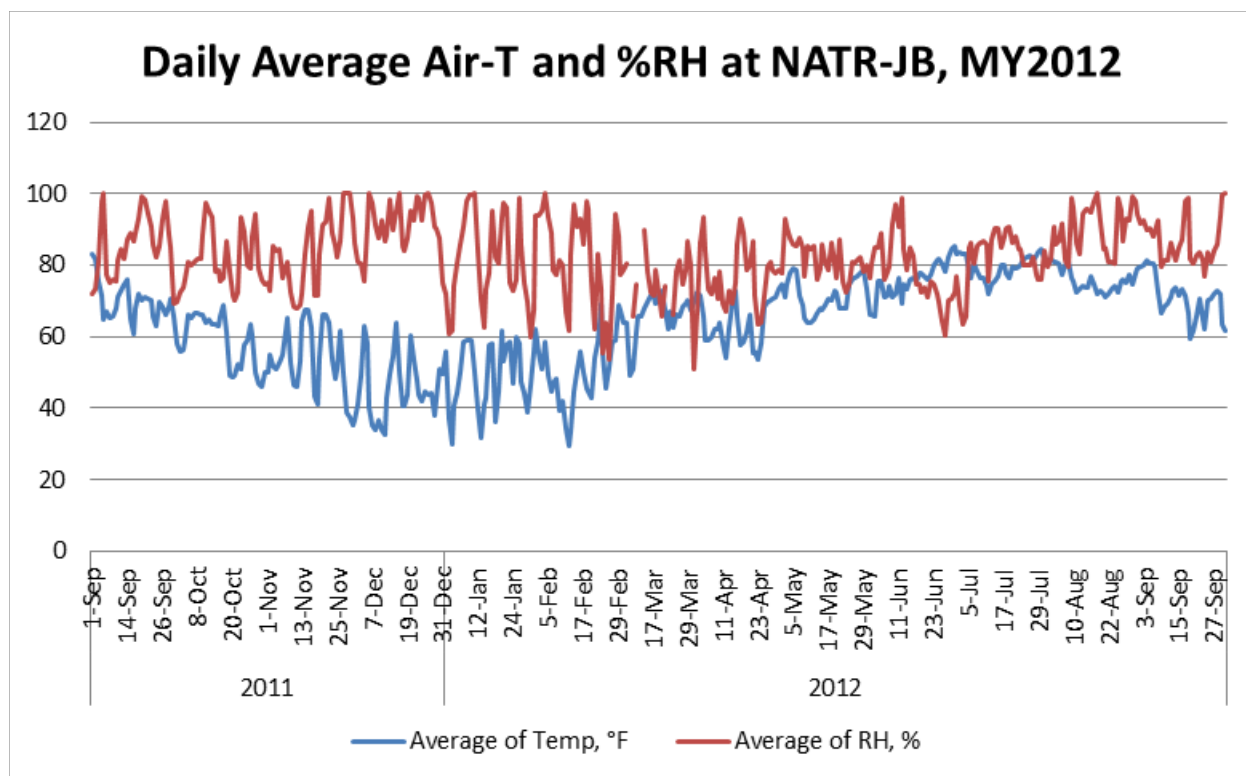


Figure 11. Monthly mean air temperature and percent-relative humidity recorded at NATR-JB riparian corridor area from SEP 01 2011 through SEP 27 2012.

## Discussion

The 22 herp species (9 amphibians, 13 reptiles) detected in NATR sampling (RS and JB sites combined) during MY 2012 represent 33 percent of the 67 species (14 amphibians, 29 reptiles) reported as being present or likely-present on NATR by the most recent park herp inventory (Hays, 2001), and only 21% of the 106 species reported in Hays, 2001, as “known from the general area of the Parkway”. It should be noted that NATR crosses four (4) ecosystem provinces and a wide diversity of habitats, and that many species are historically reported only from a few locations and specific habitats along the Trace. Many species (most turtles, many snakes, newts, *Amphiuma*, sirens) are closely or exclusively associated with aquatic systems not sampled by this study. As NATR RS and JB monitoring only samples terrestrial and arboreal assemblages, and only two of the four ecosystem provinces crossed by the Parkway are sampled, this effort has little expectation of encountering many species.

In addition, it is broadly recognized in herp monitoring and research (Graeter, et al 2010, Heyer, et al 1994) that many herp species are notably habitat-specific and no sampling method is uniformly effective for all species even within its habitat-range (i.e., CB panels sample terrestrial fauna, but are unlikely to detect box-turtles nor equally-detect all snakes, lizards, and salamanders in the area); from these factors, we accept that some species may be present and active in the sampling area but unlikely to be seen in our effort.

Of the amphibians and reptiles detected, all are considered expected and typical in the region and habitats. No detected reptiles or amphibians were identified as being “new to the park”. No obvious pathologies or abnormalities were noted in any species.

Species accumulation differed between RS and JB sites. Overall, accumulation generally tapered off before the MY ended. Detected species-count is expected to level-off with time, as the methods in use and available effort attain their maximum likely detection of species in the sampled area. As both amphibian and reptile species did level off in the MY, it appears possible that the project may have approached this hypothetical maximum detected species-count for the areas being sampled, and it may be reasonable to anticipate that few additional species will be added to the monitoring detection list into the nearer future.

The recorded air-T and %RH indicated no extreme variation or apparent departures from anticipated pattern and ranges in MY2012; the lack of large and abrupt changes likely indicates that no substantial weather changes occurred in the sampling period. This would suggest that faunal detections recorded in MY2012 did not reflect any strong impacts from unusual weather shifts or events.

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## Appendix A

NATR Project Data. The following tables present all faunal observation data recorded at the NATR-RS and NATR-JB sampling areas in Monitoring Year 2012.

Table 1. NATR-JB

| Date      | Species                      | Common Name                  | Number Observed | Avg. SVL (mm) | Avg. TL (mm) | Trap Type |
|-----------|------------------------------|------------------------------|-----------------|---------------|--------------|-----------|
| 10/5/2011 | <i>Lampropeltis getula</i>   | Speckled Kingsnake           | 1               | 60            | 70           | CB        |
| 10/5/2011 | <i>Scincella lateralis</i>   | Ground Skink                 | 1               | 41            |              | CB        |
| 10/5/2011 | <i>Hyla chrysoscelis</i>     | Cope's Gray Treefrog         | 1               | 41            |              | PVC       |
| 11/9/2011 | <i>Diadophis punctatus</i>   | Ring-necked Snake            | 1               | 185           | 224          | CB        |
| 11/9/2011 | <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 5               | 61.2          |              | CB        |
| 11/9/2011 | <i>Scincella lateralis</i>   | Ground Skink                 | 1               | 48            | 104          | CB        |
| 11/9/2011 | <i>Scincella lateralis</i>   | Ground Skink                 | 3               | 32.666667     |              | CB        |
| 12/7/2011 | <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 2               | 65.5          |              | CB        |
| 1/4/2012  | <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 1               | 42            | 91           | CB        |
| 2/8/2012  | <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 3               | 60            | 125.66667    | CB        |
| 3/7/2012  | <i>Eumeces fasciatus</i>     | Five-lined Skink             | 1               | 63            | 140          | CB        |
| 3/7/2012  | <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 3               | 52.333333     | 104.66667    | CB        |
| 3/7/2012  | <i>Scincella lateralis</i>   | Ground Skink                 | 1               | 49            | 107          | CB        |
| 3/7/2012  | <i>Anolis carolinensis</i>   | Green Anole                  | 3               | 51            | 135          | PVC       |
| 3/7/2012  | <i>Hyla chrysoscelis</i>     | Cope's Gray Treefrog         | 3               | 38.666667     |              | PVC       |
| 4/5/2012  | <i>Ambystoma opacum</i>      | Marbled Salamander           | 1               | 58            | 101          | CB        |
| 4/5/2012  | <i>Carphophis amoenus</i>    | Midwestern Worm Snake        | 1               | 206           | 234          | CB        |
| 4/5/2012  | <i>Eumeces laticeps</i>      | Broad-headed Skink           | 1               | 95            | 235          | CB        |
| 4/5/2012  | <i>Plethodon mississippi</i> | Mississippi Slimy Salamander | 1               | 64            | 125          | CB        |
| 4/5/2012  | <i>Scincella lateralis</i>   | Ground Skink                 | 1               | 41            | 87           | CB        |
| 5/2/2012  | <i>Ambystoma opacum</i>      | Marbled Salamander           | 1               | 60            | 104          | CB        |
| 5/2/2012  | <i>Coluber constrictor</i>   | Black Racer                  | 1               | 942           | 1197         | CB        |

| Date      | Species                    | Common Name                 | Number Observed | Avg. SVL (mm) | Avg. TL (mm) | Trap Type |
|-----------|----------------------------|-----------------------------|-----------------|---------------|--------------|-----------|
| 5/2/2012  | Gastrophryne carolinensis  | Eastern Narrow-mouthed Toad | 1               | 21            |              | CB        |
| 5/2/2012  | Scincella lateralis        | Ground Skink                | 2               | 40            | 83.5         | CB        |
| 5/2/2012  | Hyla chrysoscelis          | Cope's Gray Treefrog        | 2               | 0             | 33           | PVC       |
| 6/6/2012  | Eumeces fasciatus          | Five-lined Skink            | 1               |               |              | CB        |
| 6/6/2012  | Hyla chrysoscelis          | Cope's Gray Treefrog        | 5               | 35.4          |              | PVC       |
| 6/6/2012  | Eurycea guttolineata       | Three-lined Salamander      | 2               |               |              | COBS      |
| 6/6/2012  | Lithobates sphenoccephalus | Southern Leopard Frog       | 2               |               |              | COBS      |
| 6/6/2012  | Anolis carolinensis        | Green Anole                 | 1               |               |              | COBS      |
| 7/6/2012  | Coluber constrictor        | Black Racer                 | 1               | 981           | 1284         | CB        |
| 7/6/2012  | Eumeces fasciatus          | Five-lined Skink            | 1               | 64            | 144          | CB        |
| 7/6/2012  | Pseudacris crucifer        | Spring Peeper               | 1               | 32            |              | CB        |
| 7/6/2012  | Sceloporus undulatus       | Eastern Fence Lizard        | 1               |               | 100          | CB        |
| 7/6/2012  | Scincella lateralis        | Ground Skink                | 1               |               |              | CB        |
| 7/6/2012  | Hyla chrysoscelis          | Cope's Gray Treefrog        | 1               | 35            |              | PVC       |
| 8/9/2012  | Eumeces sp.                |                             | 4               |               | 162.5        | CB        |
| 8/9/2012  | Gastrophryne carolinensis  | Eastern Narrow-mouthed Toad | 1               |               | 27           | CB        |
| 8/9/2012  | Scincella lateralis        | Ground Skink                | 2               | 41.5          | 74.5         | CB        |
| 8/9/2012  | Hyla chrysoscelis          | Cope's Gray Treefrog        | 4               |               | 41           | PVC       |
| 9/6/2012  | Anaxyrus fowleri           | Fowler's Toad               | 1               |               | 31           | CB        |
| 9/6/2012  | Gastrophryne carolinensis  | Eastern Narrow-mouthed Toad | 1               |               | 31           | CB        |
| 9/6/2012  | Scincella lateralis        | Ground Skink                | 7               | 40.333333     | 96.5         | CB        |
| 9/6/2012  | Anolis carolinensis        | Green Anole                 | 1               | 63            | 157          | PVC       |
| 9/6/2012  | Hyla chrysoscelis          | Cope's Gray Treefrog        | 4               |               | 42.25        | PVC       |
| 10/3/2012 | Coluber constrictor        | Black Racer                 | 1               |               |              | COBS      |

Table 2. NATR-RS

| Start Date | Species               | Common Name                  | Number Observed | Avg. SVL (mm) | Avg. TL (mm) | Expr1 |
|------------|-----------------------|------------------------------|-----------------|---------------|--------------|-------|
| 10/4/2011  | Anaxyrus fowleri      | Fowler's Toad                | 1               | 46            |              | CB    |
| 10/4/2011  | Plethodon mississippi | Mississippi Slimy Salamander | 1               | 65            |              | CB    |
| 10/4/2011  | Scincella lateralis   | Ground Skink                 | 4               | 35.75         |              | CB    |
| 10/4/2011  | Anolis carolinensis   | Green Anole                  | 1               | 52            |              | PVC   |
| 11/8/2011  | Anaxyrus fowleri      | Fowler's Toad                | 1               | 45            |              | CB    |
| 11/8/2011  | Plethodon mississippi | Mississippi Slimy Salamander | 1               | 62            |              | CB    |
| 11/8/2011  | Scincella lateralis   | Ground Skink                 | 5               | 33.5          |              | CB    |
| 11/8/2011  | Hyla chrysoscelis     | Cope's Gray Treefrog         | 1               | 35            |              | PVC   |
| 11/8/2011  | Anolis carolinensis   | Green Anole                  | 2               |               |              | COBS  |
| 12/6/2011  | Plethodon mississippi | Mississippi Slimy Salamander | 1               | 58            |              | CB    |
| 12/6/2011  | Plethodon websteri    | Webster's Salamander         | 1               | 32            |              | CB    |
| 1/3/2012   | Ambystoma opacum      | Marbled Salamander           | 1               | 64            | 103          | CB    |
| 1/3/2012   | Elaphe guttata        | Corn Snake                   | 1               | 775           | 925          | CB    |
| 1/3/2012   | Plethodon websteri    | Webster's Salamander         | 2               | 34            | 62           | CB    |
| 1/3/2012   | Hyla chrysoscelis     | Cope's Gray Treefrog         | 1               | 0             |              | PVC   |
| 2/7/2012   | Ambystoma opacum      | Marbled Salamander           | 1               | 42            | 78           | CB    |
| 2/7/2012   | Scincella lateralis   | Ground Skink                 | 1               | 27            | 66           | CB    |
| 3/6/2012   | Elaphe guttata        | Corn Snake                   | 1               | 825           | 970          | CB    |
| 3/6/2012   | Lampropeltis getula   | Common Kingsnake             | 1               | 498           | 640          | CB    |
| 3/6/2012   | Plethodon mississippi | Mississippi Slimy Salamander | 6               | 60.833333     | 118.83333    | CB    |

| Start Date | Species                      | Common Name                  | Number Observed | Avg. SVL (mm) | Avg. TL (mm) | Expr1 |
|------------|------------------------------|------------------------------|-----------------|---------------|--------------|-------|
| 3/6/2012   | Scincella lateralis          | Ground Skink                 | 4               | 36.666667     | 78.333333    | CB    |
| 3/6/2012   | Hyla chrysoscelis            | Cope's Gray Treefrog         | 1               | 42            |              | PVC   |
| 4/3/2012   | Carphophis amoenus           | Midwestern Worm Snake        | 1               | 143           | 164          | CB    |
| 4/3/2012   | Plethodon mississippi        | Mississippi Slimy Salamander | 1               | 64            | 131          | CB    |
| 5/1/2012   | Anaxyrus fowleri             | Fowler's Toad                | 3               |               | 48           | CB    |
| 5/1/2012   | Lampropeltis getula          | Common Kingsnake             | 1               | 484           | 544          | CB    |
| 5/1/2012   | Scincella lateralis          | Ground Skink                 | 4               | 56            | 100          | CB    |
| 5/1/2012   | Scincella lateralis          | Ground Skink                 | 1               |               |              | COBS  |
| 6/5/2012   | Agkistrodon contortrix       | Copperhead                   | 1               | 750           | 850          | CB    |
| 6/5/2012   | Anaxyrus fowleri             | Fowler's Toad                | 2               | 30            | 60           | CB    |
| 6/5/2012   | Diadophis punctatus          | Ring-necked Snake            | 1               | 215           | 256          | CB    |
| 6/5/2012   | Scincella lateralis          | Ground Skink                 | 5               | 45.333333     | 88.333333    | CB    |
| 6/5/2012   | Anaxyrus fowleri             | Fowler's Toad                | 2               |               |              | COBS  |
| 6/5/2012   | Scincella lateralis          | Ground Skink                 | 2               |               |              | COBS  |
| 6/5/2012   | Terrapene carolina triunguis | Three-toed Box Turtle        | 1               |               |              | COBS  |
| 7/3/2012   | Anaxyrus fowleri             | Fowler's Toad                | 1               | 54            |              | CB    |
| 7/3/2012   | Scincella lateralis          | Ground Skink                 | 7               | 45            | 100          | CB    |
| 7/3/2012   | Thamnophis sirtalis          | Common Garter Snake          | 1               | 575           | 696          | CB    |
| 8/8/2012   | Anaxyrus fowleri             | Fowler's Toad                | 1               |               | 44           | CB    |
| 8/8/2012   | Scincella lateralis          | Ground Skink                 | 5               | 42.333333     | 64.666667    | CB    |
| 8/8/2012   | Hyla chrysoscelis            | Cope's Gray Treefrog         | 1               |               | 43           | PVC   |

| Start Date | Species             | Common Name         | Number Observed | Avg. SVL (mm) | Avg. TL (mm) | Expr1 |
|------------|---------------------|---------------------|-----------------|---------------|--------------|-------|
| 9/5/2012   | Anaxyrus fowleri    | Fowler's Toad       | 1               |               | 45           | CB    |
| 9/5/2012   | Scincella lateralis | Ground Skink        | 5               | 25.75         | 61           | CB    |
| 9/5/2012   | Anolis carolinensis | Green Anole         | 1               |               |              | COBS  |
| 10/2/2012  | Thamnophis sirtalis | Common Garter Snake | 1               |               |              | COBS  |
| 10/30/2012 | Anolis carolinensis | Green Anole         | 5               |               |              | COBS  |
| 10/30/2012 | Scincella lateralis | Ground Skink        | 1               |               |              | COBS  |
| 12/4/2012  | Anolis carolinensis | Green Anole         | 1               |               |              | COBS  |