# 2002 PROGRESS REPORT

# ON HERPETOFAUNA INVENTORIES

# OF SOUTHERN COLORADO PLATEAU NATIONAL PARKS

**Western Banded Gecko from Wupatki National Monument, Arizona**

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## INTRODUCTION

In fiscal year 2000, the Park Service received a substantial budget increase for inventory and monitoring studies, and a nationwide program to inventory vertebrates and vascular plants within the national parks was begun in earnest. As part of this new inventory effort led by the Inventory and Monitoring office, a total of 265 National Park units (parks, monuments, recreation areas, historic sites, etc.) were identified as having significant natural resources, and these were divided into 32 groups or "networks" based on geographical proximity and similar habitat types. The many NPS areas on the Colorado Plateau of Utah, northern Arizona, northwestern New Mexico, and western Colorado were divided into a northern and a southern network. An inventory plan ("Biological Inventory of National Park Areas on the Southern Colorado Plateau") was developed in 2000 for the 19 park units in the southern Colorado Plateau (SCP) network (Stuart 2000).

Long-term biological inventory goals for each park are to provide: (1) complete bibliographies of studies pertinent to biological inventory of network parks; (2) detailed summaries of biological survey and natural history specimen data for the network parks; (3) species lists for each taxonomic group in relational database and hard copy format; (4) relative abundance estimates for selected species of concern in each vertebrate and vascular plant taxonomic group; (5) spatially located data for species of interest or concern; (6) spatial data on sampling site locations for GIS and a GIS data browser; (7) pertinent herbarium and museum vouchers databases; and, (8) recommendations for long-term monitoring within the network.

In the first year (2001) of reptile and amphibian inventories in the SCP network, we surveyed the following park units: Aztec Ruins National Monument (AZRU), El Morro National Monument (ELMO), Petroglyph National Monument (PETR), Salinas Pueblo Missions National Monument (SAPU), Sunset Crater Volcano National Monument (SUCR), Walnut Canyon National Monument (WACA), Wupatki National Monument (WUPA), and Yucca House National

Monument (YUHO). In addition, Hovenweep National Monument (HOVE) was transferred from the NCP to the SCP network due to its close proximity to several SCP parks being surveyed. In 2002 we began inventory work at Bandelier National Monument (BAND), Chaco Culture National Historic Site (CHCU), and El Malpais National Monument (ELMA), and we continued fieldwork at the original nine parks.

Most of these parks have little or no information available on the reptile and amphibian species that occur within them, and species presence has not been adequately documented at most of them. With such a lack of baseline information, the parks have no ability to develop management policies for the herpetofauna, and they also generally lack knowledge of the occurrence of rare or sensitive species. These parks have the highest priority needs for herpetofauna inventories.

### Objectives

The overall goals of our inventory are to: 1) provide each park with a baseline inventory of reptiles and amphibian in major habitats within the park with the goal of documenting 90% of the species present; 2) identify park-specific species of special concern (which could become part of future "vital signs" monitoring); and 3) based on the inventory, recommend an effective monitoring program so that Resource Management staff at each park can assess the condition of amphibian and reptile populations over time, and detect significant changes in those populations.

## STUDY AREA DESCRIPTION

Our study area covered much of the southern Colorado Plateau, as well as the adjacent Rio Grande Valley area of north-central New Mexico. Figure 1 shows the location of each park surveyed in the SCP network. Stuart (2000) gives more precise descriptions of the habitat and other features of each park unit. In addition, we surveyed at Hovenweep National Monument (HOVE), originally assigned to the Northern Colorado Plateau network. HOVE is located in extreme southeastern Utah and southwestern Colorado.


**Figure 1**. Location of National Park Service units in the SCP network. See Stuart (2000) for a description of park clusters. Twelve parks were inventoried for reptiles and amphibians in 2002: AZRU, BAND, CHCU, ELMA, ELMO, PETR, SAPU, SUCR, WACA, WUPA, and YUHO. In addition, HOVE was included for reptile and amphibian surveys. See text for abbreviations.

## METHODS

### Visual Survey Methods

Time-area constrained searches (TACS) are a version of visual encounter surveys defined by Crump and Scott (1994) in which not only the amount of time spent searching, but also the area covered, are standardized. TACS consist of walking systematically through each habitat within the sampling area for a specified amount of time, searching all reasonable areas within that habitat, and recording reptiles and amphibians encountered (Drost and Nowak 1997, Scott 1994). This method yields a number of individuals and species collected or observed per person-hour.

Using one or two people, we conducted one-hour time-constrained searches within randomly-generated one-ha plots. In contrast to 2001, in 2002 we did not conduct any non-random TACS plot surveys in any parks. We conducted random plot surveys in larger parks (i.e. BAND, CHCU, ELMA, ELMO, PETR, SUCR, WACA, and WUPA). These sites were a subset of those determined using GIS to stratify parks by habitat (see Stuart 2000). In smaller parks (i.e. AZRU, HOVE, SAPU, and YUHO) we only used general survey and nighttime road driving methods.

In 2001, all TACS plots were one hectare (ha) in size, generally 100 meters square. In some areas, we were forced to move the plot center or change its shape to stay within a given habitat type. For each plot, we recorded the location of center point in UTMs using a global positioning system (GPS) unit, as well as plot dimensions and orientation if different from cardinal bearings (N, S, E, W). We also photographed and described the topography, elevation, slope, aspect, vegetation, and non-vegetative cover of each plot using data sheets developed in conjunction with the database manager for the Southern Colorado Plateau I&M Network (Appendix A).

In 2002, some of the TACS plot surveys were altered to be time constrained but functionally area-unconstrained. These surveys were conducted like the regular 1 ha plots, but we surveyed over a wider area (between 1 and 10 ha; henceforth referred to as "10-ha TACS") centered on the random point. We allowed ourselves to cover an area up to 10 ha, but given that we were limited to an hour, it was unlikely that we ever covered such a large area. Instead, we targeted favorable microhabitats in order to increase the probability of finding more species on each survey. These surveys represented a compromise between the flexibility of the general surveying technique (below), and the statistically based criterion of random survey points.

We conducted visual encounter surveys that were not time or area-limited. In these "general surveys," we sampled habitats that appeared to be of high quality for reptiles or amphibians, were otherwise unique, and/or not represented by TACS plots. The focus of this method was to search selected microhabitats opportunistically without necessarily covering a given area thoroughly. Most of these general surveys were conducted during the day, but we also conducted some at night. Nocturnal general surveys were used primarily to search amphibian breeding areas and document calling and/or larvae. Usually these surveys were conducted by walking, but at YUHO, where amphibian breeding habitats are scattered over a large area, we drove between sites.

Amphibians and reptiles seen incidental to other fieldwork by us or seen by park staff were referred to as "random encounters." As with the amphibians and reptiles seen or captured by the different sampling methods described above, we recorded standard data on random encounters, including date, time, location, species, and size measurements and sex (if the animal was captured).

**Road or Night Driving Surveys**

Driving slowly on roads at night and carefully scanning the road in the headlights of the vehicle is recognized as an excellent method for surveying some groups of reptiles, particularly snakes (e.g., Klauber 1939, Mendelson and Jennings 1992, Rosen and Lowe 1994). This method is also effective for surveying amphibians (Shaffer and Juterbock 1994), particularly in the arid southwest where many anuran species are seldom active during daytime, but can often be found crossing roads on warm, rainy nights. Although suitable paved or hard-packed dirt roads within or adjacent to most of the parks we surveyed were minimal, we conducted limited road driving at all parks on warm, rainy summer nights.

We standardized night driving surveys by driving a vehicle at slow speeds (30-40 km per hour) on park roads, identifying all amphibians and reptiles encountered to species and recorded if they were either alive on the road (AOR) or dead on the road (DOR), sexing and aging all individuals, as possible, and recording locations to the nearest 0.1 mi using calibrated vehicle odometers.

**Voucher Specimens**

We attempted to document the presence of each species at each park by collecting at least one individual of each species at each park. In some instances, specimens already exist in institutional collections from some parks, eliminating the need for us to collect individuals of those species. Though many individuals were taken alive and humanely euthanized, we also salvaged many animals that were found dead on roads in or near the parks. Specimens were injected with and immersed in 10% formalin for fixing, then transferred to 55% isopropyl alcohol for preservation, using standard techniques (e.g. Pisani 1973). At the conclusion of the study, these specimens will be deposited primarily in the herpetological collections at the Museum of Southwestern Biology (MSB), University of New Mexico, and some will be deposited in the Flagstaff Area National Monuments vertebrate collection. Each specimen will have a National Park Service issue specimen tag containing information on species, collector, date of collection, collection site, and National Park Service (ANCS+) catalog numbers.

**Data Analyses**

Sampling site locations and selected capture locations of individual animals were recorded using either a GARMIN® GPSIII Plus or Garmin 12 GPS unit in the datum NAD 27. These data will be mapped at a later date by the database manager for the Southern Colorado Plateau I&M Network.

The effectiveness of the different sampling methods was estimated by determining overall species diversity and capture rate per unit effort for each of the sampling methods. The number

of species or individuals captured per unit effort was estimated by dividing the number captured or sighted by the total effort for that method or time period. The amount of sampling effort was measured as number of hours spent on each survey multiplied by the number of people per survey (person-hours).

To estimate inventory completeness, we first compared our results with master lists of potentially occurring species. Development of the preliminary master list of potentially occurring species was based on consultation of selected literature sources (e.g. Degenhardt et al. 1996, Hammerson 1999), extensive personal knowledge of the distribution and habitats of southwestern amphibians and reptiles, preliminary data from selected museum collections, and results of fieldwork from the 2001 and 2002 seasons.

In addition to master lists, we used species accumulation curves (e.g. Scott 1994) to estimate inventory completeness. Species accumulation curves were generated for all parks using Microsoft Excel. We may also, if possible, use mark-recapture based models (e.g. Burnham and Overton 1979) to estimate inventory completeness, as recommended in the original inventory plan (Stuart 2000). However, the necessary statistical condition of equal detectability of species is clearly strongly violated in surveys of amphibians and reptiles. Because mark-recapture models require the use of random (i.e. plot survey) data, results can only reasonably be applied to lizards, the group best suited to daytime, visual encounter survey techniques.

## RESULTS AND DISCUSSION

**Overview of Inventory Results**. During herpetological inventories at 12 National Park Service units in the Southern Colorado Plateau Network (including HOVE) from May to September 2002, we documented 37 amphibian and reptile species, including one salamander species, seven anuran species, 17 lizard species, and 12 snake species (Appendix B). Scientific (Latin) names for these and other species mentioned in the report are found in Appendix D. Based on last year's surveys, as well as new literature and museum searches at parks surveyed in 2001, fieldwork in 2002 added new species at ELMO (Short-horned Lizard, Night Snake), PETR (Texas Blind Snake), WACA (New Mexico Spadefoot), and WUPA (Tiger Salamander, Western Banded Gecko). Based on a review of previous surveys and literature and museum searches at parks new for 2002, we added new species at BAND (Graham Patchnose Snake), CHCU (Night Snake, Western Terrestrial Garter Snake), and ELMA (Plains Spadefoot). In addition, we vouchered (collected) a number of species at many parks that had previously been documented only by observations. Based on new discoveries in 2002, and inclusion of available museum and literature data on species occurrence, we estimate our inventory completeness for all parks surveyed to be 69%.

**Sampling Effort and Efficacy of Methods**. We spent approximately 766 person-hours (i.e., the number of people conducting any given survey multiplied by the number of hours per survey) on inventories for amphibians and reptiles between April and September 2002 at 12 different parks. The total amount of time, in person-hours, spent on each sampling method at each park is summarized in Table 1.

**Table 1.** Sampling time in person-hours for amphibian and reptile survey methods during inventories of 12 Southern Colorado Plateau National Park areas, April-September 2002. The total sampling time is summarized for each park and each method in bold type. See text for details.

| METHOD | AZRU | BAND | CHCU | ELMA | ELMO | HOVE | PETR | SAPU | SUCR | WACA | WUPA | YUHO | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RANDOM PLOTS - 1 HA | - | 5.23 | 7.38 | 20.8 | 6.08 | - | 3.68 | - | 5.65 | 7.68 | 6.25 | - | **62.7** |
| RANDOM PLOTS - 10 HA | - | 5.00 | 8.33 | 9.33 | 6.18 | - | 9.07 | - | 6.95 | 10.9 | 11.3 | - | **67.1** |
| **TOTAL PLOTS** | **0** | **10.2** | **15.7** | **30.1** | **12.3** | **0** | **12.7** | **0** | **12.6** | **18.6** | **17.5** | **0** | **130** |
| | | | | | | | | | | | | | |
| GENERAL SURVEYS | 26.3 | 86.8 | 46.5 | 15.1 | 38.0 | 47.2 | 23.0 | 50.9 | 4.07 | 48.3 | 61.3 | 27.3 | **475** |
| NOCT. GENERAL SURVEYS | 5.17 | 12.2 | 6.83 | 0.75 | 1.43 | 0.75 | 3.17 | 5.02 | - | 0.83 | - | 4.03 | **40.2** |
| **TOTAL GS** | **31.5** | **99** | **53.3** | **15.8** | **39.4** | **47.9** | **26.2** | **55.9** | **4.07** | **49.1** | **61.3** | **31.3** | **515** |
| | | | | | | | | | | | | | |
| NIGHT DRIVES | 2.75 | 1.63 | 30.6 | 15.4 | 12.1 | 14.9 | - | 12.6 | 3.43 | 5.08 | 22.9 | - | **121** |
| **TOTAL EFFORT** | **34.2** | **111** | **99.6** | **61.3** | **63.8** | **62.8** | **38.9** | **68.5** | **20.1** | **72.8** | **102** | **31.3** | **766** |

We spent the most time sampling at the larger parks, with the exception of PETR. Petroglyph received proportionally less effort because we targeted second-year sampling effort in parks where we would be most likely to significantly increase species completeness (i.e. parks where we had the best chance of finding the most expected species, such as HOVE and SAPU). SUCR received the least amount of sampling effort due to its small size, its high elevation, and to the paucity of suitable habitat there for reptile and especially amphibian species. We resumed sampling at ELMO in 2002 and proportionally increased our effort there due to the abruptly short season in 2001.

As in 2001, we spent the greatest amount of sampling time in most parks on general surveys. This was not accidental, as we have seen in previous studies in the region that this method consistently tends to detect greater numbers of both species and individuals per unit effort than other methods (e.g. Nowak et al. 2002, Drost et al. 2001). We then focused on 1- and 10-ha random plots to provide repeatable and quantifiable sampling. We spent the least amount of time conducting nocturnal general surveys, as many of the parks did not contain easily accessible

amphibian breeding areas. AT YUHO and PETR, night drives were included as part of nocturnal general surveys due to the limited suitability of roads in those areas for detecting animals via night driving (at YUHO due to the absence of paved surfaces and at PETR due to the urban, high-traffic environment).

The amount of time spent on each method was not necessarily correlated with either the total number of individuals or species detected by that method, nor the rate at which individuals were detected. Appendix C lists the numbers of individuals and species detected by each method for each park. For initial ease of comparison, these numbers were tallied across all parks and the number of individuals detected per unit effort was calculated for each taxa (Table 2). If useful, we will examine the efficacy of different methods in each park in the final report to make park-specific monitoring method recommendations.

**Table 2**. Total number of individuals, individual detection rate per unit effort, and total number of species detected by different methods during a herpetological inventory of twelve southern Colorado Plateau National Parks, April-September 2002. Amount of effort was measured in person-hours. The total number of individual amphibians does not include estimations of the number of individuals in large larval or egg masses.

| | 1-Ha Random Plots | 10-Ha Random Plots | All Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters |
|---|---|---|---|---|---|---|---|
| **AMPHIBIANS** | | | | | | | |
| Individuals | 0 | 3 | 3 | 74 + eggs and larvae | 83 | 144 | 9 |
| Individuals / Effort | 0 | 0.04 | 0.04 | > 0.15 | 2.06 | 1.19 | X |
| Species | 0 | 2 | 2 | 5 | 7 | 5 | 1 |
| **LIZARDS** | | | | | | | |
| Individuals | 189 | 278 | 467 | 1724 | 2 | 13 | 105 |
| Individuals / Effort | 3.01 | 4.14 | 3.59 | 3.63 | 0.05 | 0.11 | X |
| Species | 9 | 12 | 12 | 17 | 2 | 7 | 13 |
| **SNAKES** | | | | | | | |
| Individuals | 2 | 5 | 7 | 101 | 4 | 36 | 19 |
| Individuals / Effort | 0.03 | 0.07 | 0.05 | 0.21 | 0.10 | 0.30 | X |
| Species | 2 | 3 | 4 | 8 | 3 | 7 | 4 |
| **TOTAL** | | | | | | | |
| **Individuals** | **191** | **286** | **477** | **1899** | **89** | **193** | **133** |
| **Individuals / Effort** | **3.05** | **4.26** | **3.67** | **4.00** | **2.21** | **1.59** | **X** |
| **Species** | **11** | **17** | **18** | **30** | **12** | **19** | **18** |

Non-area constrained surveys detected the most species and individuals. Of these surveys, 10-ha plots (conducted with a randomly located center and covering an areas up to 10 ha) were the most effective in detecting species per unit effort. However, these plots detected mainly diurnal lizards, whereas general surveys were the most effective in detecting the highest species diversity of both lizards (especially) and snakes. In 2001, general surveys were the best method for detecting both individuals per unit effort and total number of species (Nowak et al. 2002). General survey techniques have been documented to be the best herpetological detection method for compilation of species lists in other areas as well (e.g. Campbell and Christman 1982, Scott 1994).

General surveys were particularly effective in detecting diurnal reptiles, and slightly less effective at detecting nocturnal amphibians. Most amphibians detected using this method were neotenic salamanders and anuran larvae living in pools of water.

The next most effective method in detecting individuals per unit effort was 1-ha random plots. Again, these plots were most effective at detecting diurnal lizards- they did not detect any amphibian species. It is interesting to compare the effectiveness of 1-ha and 10-ha plots. Although each had randomly-located center points, being able to survey beyond a 1-ha diameter and sample microhabitats in the area that appeared to potentially contain more diversity paid off. 10-ha plots were superior to 1-ha plots in detecting both individuals and species in all taxa. In effect, these surveys function as a type of time-constrained unbounded general survey. The poor success of both time- and (small) area-constrained randomly-selected 1-ha plots is consistent with our results from last year (Nowak et al. 2002) and with data from the Northern Colorado Plateau (Graham and Platenberg 2001), the Sonoran Desert I&M Networks (B. Powell, Sonoran Desert Inventory and Monitoring Network, pers. comm.), and Olympic National Park (M. Adams, USGS Forest and Rangeland Ecosystem Science Center, pers. comm.). This is likely due to lack of focus on taxa-specific habitat quality in GIS-generated stratification layers. Many of the randomly-selected 1-ha plots in our study were poor reptile habitat, and as no plots contained more than ephemeral drainages, they were also very poor amphibian habitat- however, the 10-ha plots were large enough to encompass amphibian breeding habitat in some parks (e.g. ELMO).

Based on our first- and second-year results, we would advise against using generically randomly-selected plots for future herpetofauna inventories, especially if they cover only small areas (1-ha). If randomly-generated plots must be used to satisfy statistical requirements and issues of repeatability, we would advise increasing the area covered by the plots. Larger plots of this type will be useful for monitoring common diurnal species. If keeping the size of the plot at 1-ha is the main consideration, we would recommend using non-randomly-generated plots (see Nowak et al. 2002). Re-stratifying the habitat based on features meaningful to herpetofauna would also increase the effectiveness of both small and large random plots. We would also recommend spending at least equal effort on other methods.

Nocturnal general surveys were very effective in detecting amphibian individuals and species, but they did not work well for other taxa, especially lizards. These results are consistent with last year's data (Nowak et al. 2002) and those of the Northern Colorado Plateau I&M Network (Graham and Platenberg 2001), but they are not consistent with those of the Sonoran Desert I&M Network, where nighttime temperatures are warmer and all herpetofauna are much more likely to be nocturnally active. The parks where nocturnal general surveys were particularly effective are located at lower elevations (e.g. SAPU and BAND along the Rio Grande). We would recommend this method only for targeting known or suspected amphibian breeding areas, and in fact this was our primary use of the method.

Night road driving was useful in detecting high numbers of both individuals and species of amphibians and snakes. It was by far the most effective method for detecting individual snakes per unit effort. In fact, as during last year, it detected species found by no other method (e.g. Lined Snake at SAPU). When paved roads (and occasionally hard-packed dirt roads) are available, they are well known as a herpetological technique of choice for detecting snakes and

amphibians (e.g. Campbell and Christman 1982, Fitch 1987, Shafer and Juterbock 1994). While road driving may never be a primary sampling method in the parks we surveyed due to the paucity of suitable roads within or adjacent to park boundaries, it should be utilized on particularly favorable warm and rainy summer nights as a targeted method to detect rarer snakes and temporily rare explosive breeding amphibian species.

Random encounters are hard to quantify as a sampling technique, but are very important in detecting rare taxa. These encounters commonly occurred while we or others were en route to conduct other sampling methods. One such random encounter was the detection of a juvenile Texas Blind Snake crossing a trail at PETR by Rich Anderson, a professor at a local Albuquerque college. To our knowledge this species has not been previously seen at the park, and we have not found it at any other park on the southern Colorado Plateau.

**Estimates of Inventory Completeness**

**Master List**. To estimate inventory completeness, we primarily compared our results with master lists of potentially occurring species. These lists have evolved over the course of the study as we uncover more information from ongoing literature and museum searches, as well as refine our knowledge of species occurrence and habitats as fieldwork progresses. Although we have not completed museum specimen and literature searches for some parks, we have now incorporated known information into our analyses of inventory completeness (see Appendix E).

Development of the preliminary master list of potentially occurring species (Appendix E) was based on consultation of selected literature sources (e.g. Degenhardt et al. 1996, Hammerson 1999), extensive personal knowledge of the distribution and habitats of southwestern amphibians and reptiles, preliminary data from selected museum collections, and results of fieldwork from the 2001-2002 seasons. Probability of species occurrence was ranked as low, medium, or high, i.e. 0-33%, 34-67%, and 68-100%. In Appendix E these three rankings are coded as 1, 2, and 3, respectively. For quantitative analysis, these rankings were converted to the midpoint of their percentage range, i.e. 0.17, 0.50, and 0.83. These values were used as weighting factors for species not yet documented. For example, two species with rankings of medium probability of occurrence would combine to equal one full expected species (0.50 x 2=1.00 species), whereas six species of low probability of occurrence would be required to equal one full expected species (0.17 x 6=1.02 species). Species found by us in 2001-2002, or known from previously collected specimens or reliable observations (primarily our own) are weighted 1.00.

Using the weighted master list approach, we estimated an overall inventory completeness of 69% for the twelve SCP parks (including HOVE) surveyed in 2001 and 2002 (Appendix E). Values for individual parks ranged from a low of 49% for both PETR and SUCR, to a high of 92% for WUPA. We expect that the ultimate documented species lists will be enhanced by the addition of museum specimen data for some parks, especially at PETR and BAND, where specimens housed at the Museum of Southwestern Biology have not yet been examined. Unfortunately, very little work has been done at the other parks, and we are unlikely to add many species by examination of museum collections and more thorough review of the literature.

**Inventory Completeness of Different Taxa Groups.** Using the same weighting methods and data from Appendix E, we calculated that overall estimated inventory completeness for amphibians is 73%, for lizards is 83%, and for snakes is 56%. Although a few turtle species likely occur in some SCP parks (Appendix E), our success rate of 0% for this group was similar to our poor success rates for both Crocodilians and Rhynchocephalians. The relatively high success rate for lizards is likely because most lizard species are diurnal and conspicuous, and our efforts (as well as others in previous surveys or collections) were biased towards daytime searches (both plots and general surveys) that easily detect such species. Most amphibians on the southern Colorado Plateau (especially spadefoot toads) breed during the summer monsoon season, and are often active on only a few nights a year, making them difficult to locate. In addition, 2001was a poor monsoon year at some parks (personal observation), as temporary pools were not found at all in some areas, and 2002 was among the worst drought years on record in much of the southwest. As with amphibians, many snake species are primarily nocturnal, and many are extremely secretive in their habits, so a low success rate for snakes is not surprising.

For both amphibians and snakes, however, the single most important factor limiting our success rate is the lack of extensive networks of roads in most of the SCP parks surveyed in 2001 and 2002. Based on data from our own studies in the region (Drost et al. 1999, 2001, Persons 2001), nighttime road surveys are by far the most effective method for detecting both amphibians and snakes. At Petrified Forest National Park (Drost et al. 1999, 2001) the combination of general daytime foot surveys for lizards and nighttime road surveys resulted in an overall estimated inventory completeness of >90%. Perhaps federal highway funds could be secured, and large paved road survey transects could be established for amphibians and reptiles in wilderness areas at many parks.

**Species Accumulation**. Species accumulation curves (plotted per survey day) for the 12 SCP parks surveyed in 2002 are shown in Figure 2a-l. For the nine parks previously surveyed in 2001, a continuous species accumulation curve is shown for 2001 and 2002 data. 2001 survey days are separated from 2002 survey dates by a vertical line through the data. Total number of species detected may not match up with those given in Appendices C and E because only the species we actually observed in the parks are included in these curves. For the three parks new to the inventory in 2002, we have also included the accumulation curves for three different methods.

**Figure 2a. 2001 AND 2002 AZRU SPECIES ACCUMULATION**
**(all methods combined)**

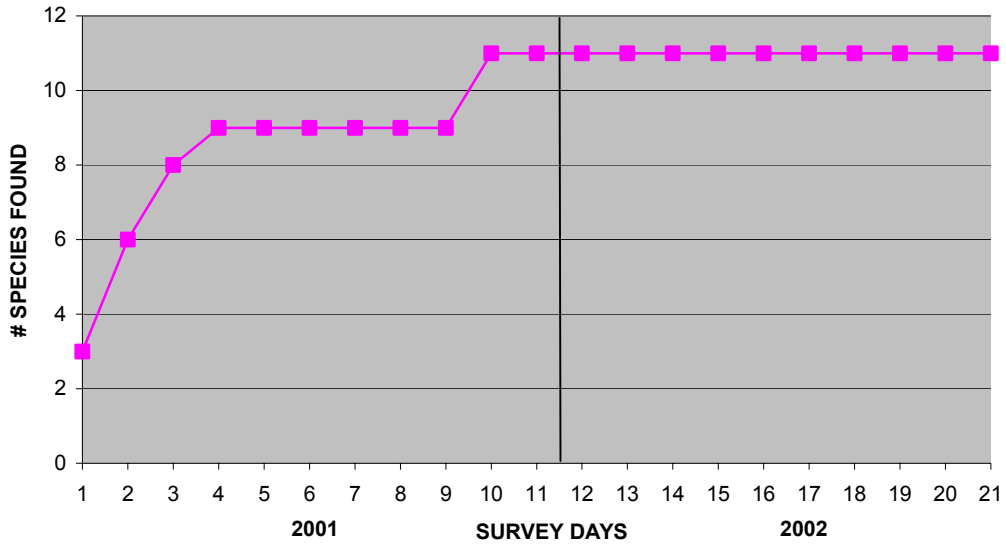



**Figure 2b. 2002 BAND SPECIES ACCUMULATION**

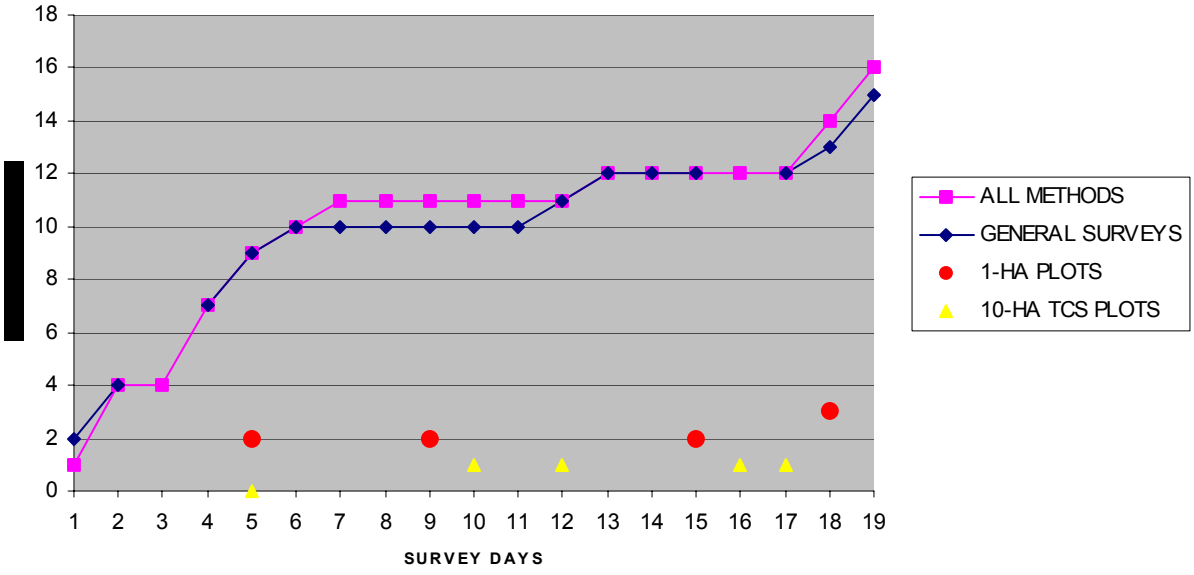


**Figure 2c. 2002 CHCU SPECIES ACCUMULATION**

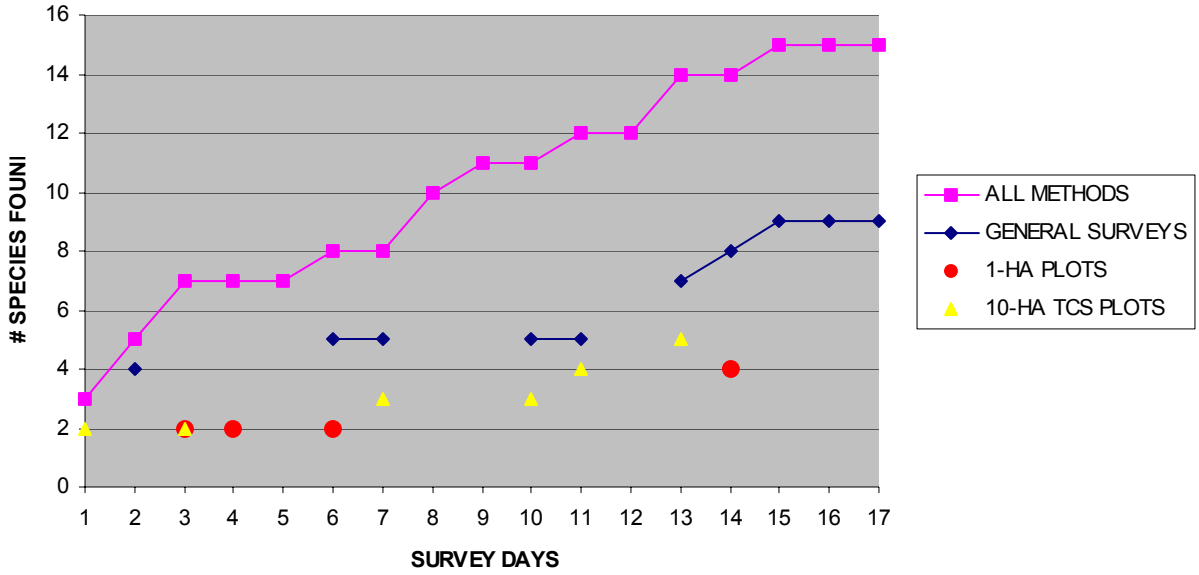



**Figure 2d. 2002 ELMA SPECIES ACCUMULATION**

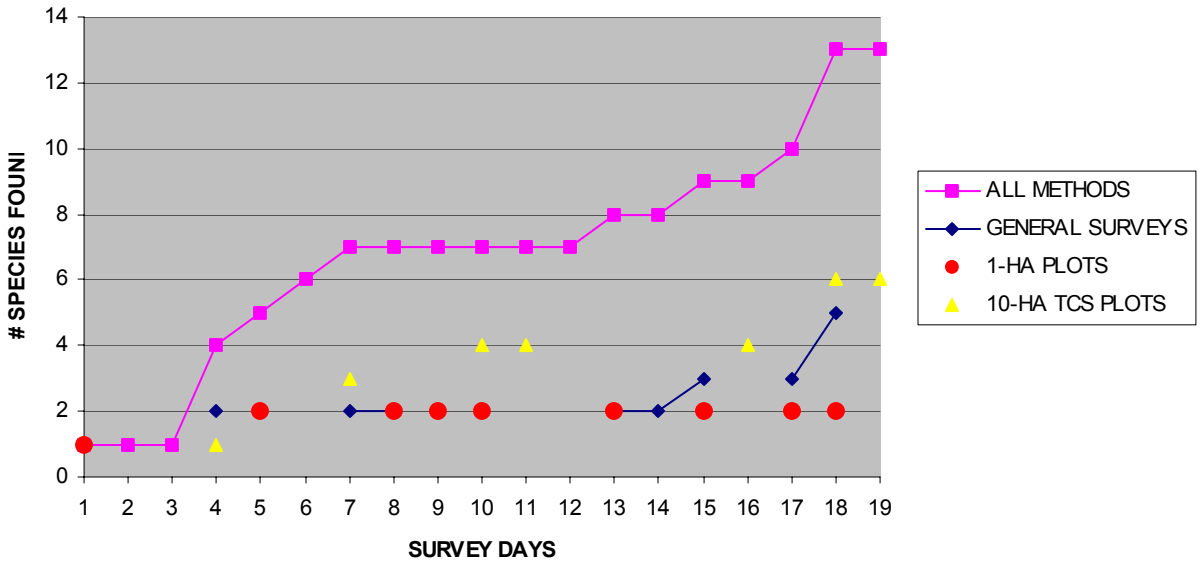


**Figure 2e. 2001 AND 2002 ELMO SPECIES ACCUMULATION (all methods combined)**

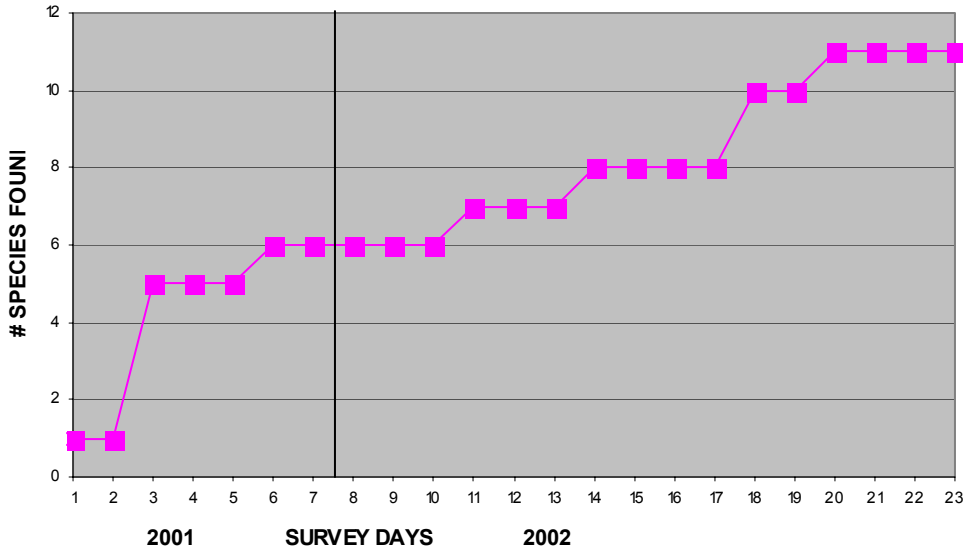



**Figure 2f. 2001 AND 2002 HOVE SPECIES ACCUMULATION (all methods combined)**

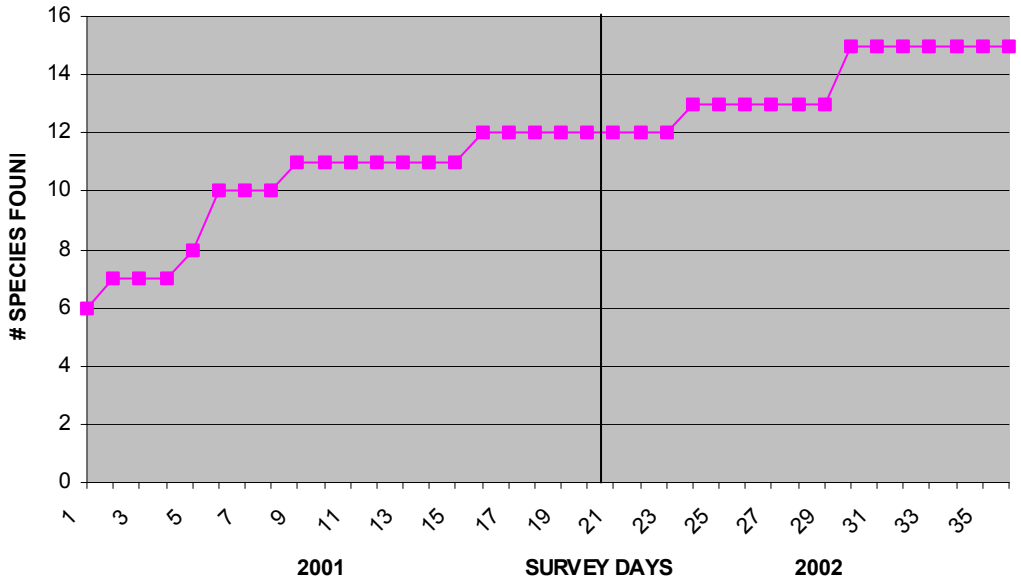


**Figure 2g. 2001 AND 2002 PETR SPECIES ACCUMULATION (all methods combined). * indicates species found by others**

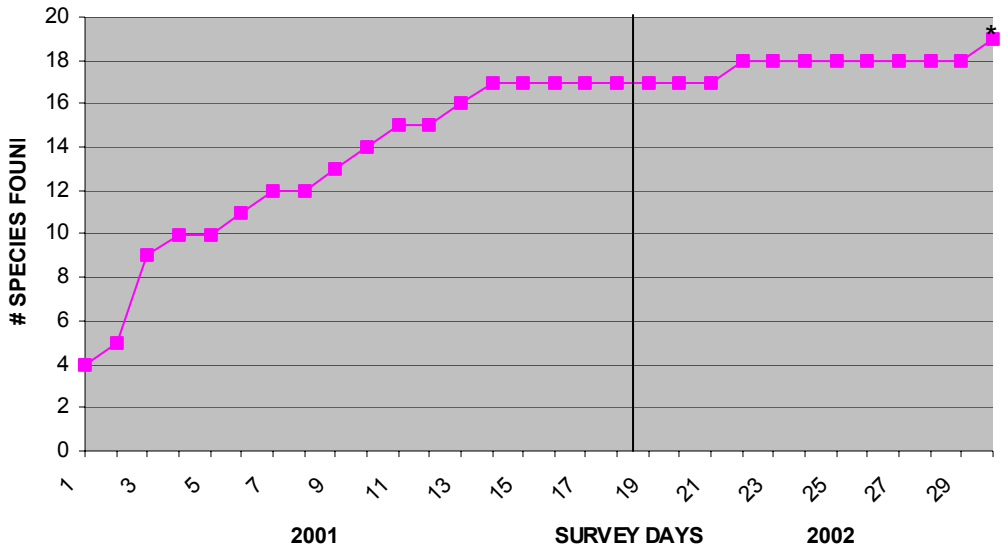



**Figure 2h. 2001 AND 2002 SAPU SPECIES ACCUMULATION (all methods combined)**

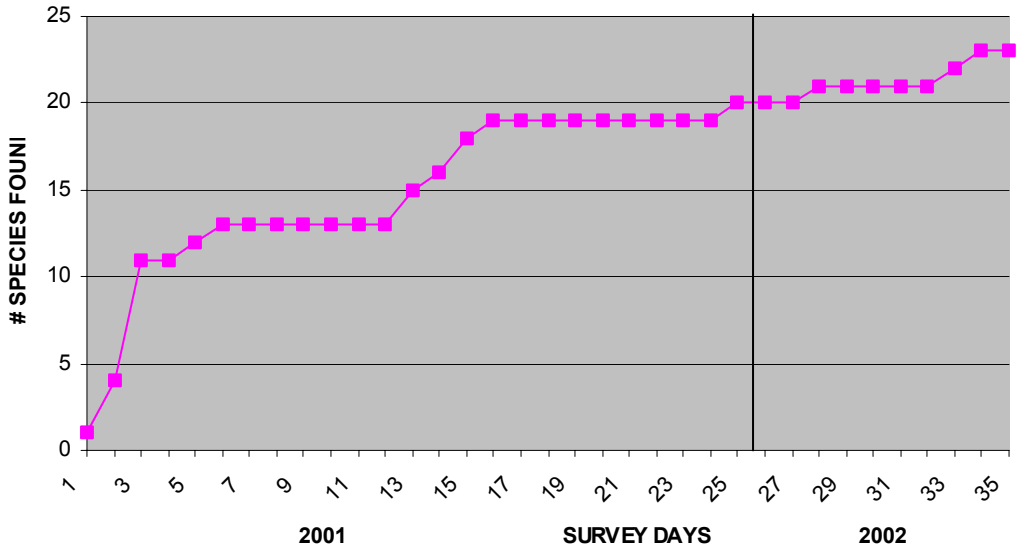


**Figure 2h. 2001 AND 2002 SUCR SPECIES ACCUMULATION**
**(all methods combined)**

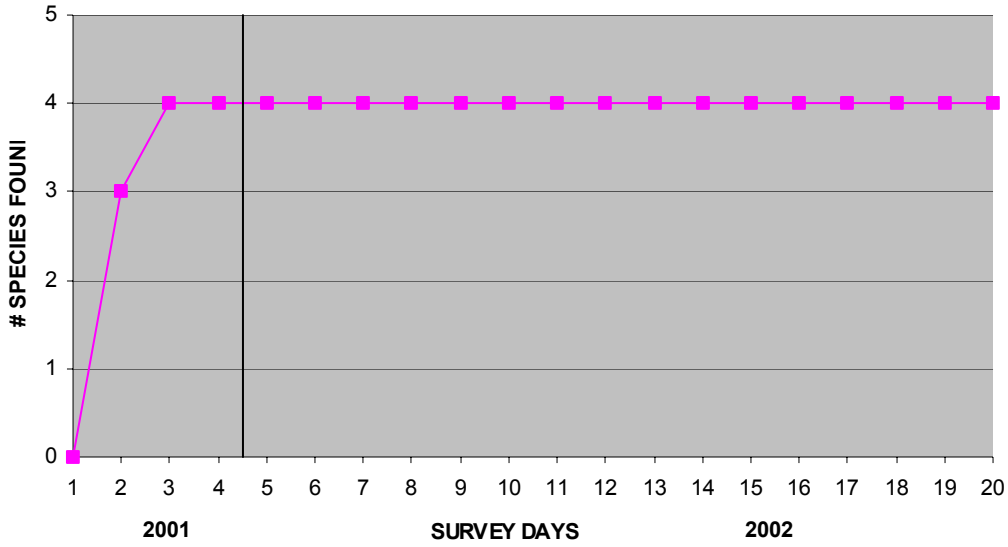



**Figure 2h. 2001 AND 2002 WACA SPECIES ACCUMULATION**
**(all methods combined)**

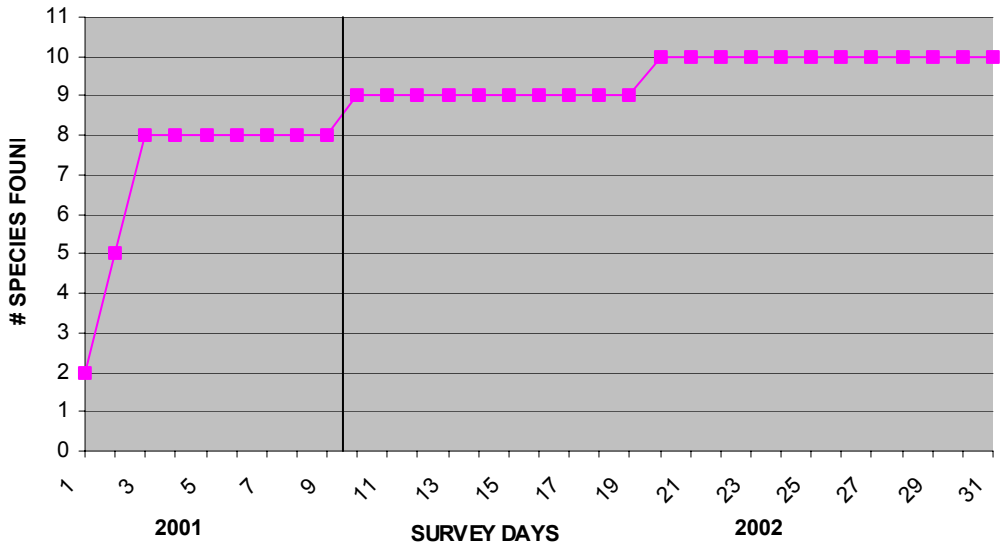


**Figure 2k. 2001 AND 2002 WUPA SPECIES ACCUMULATION (all methods combined)**

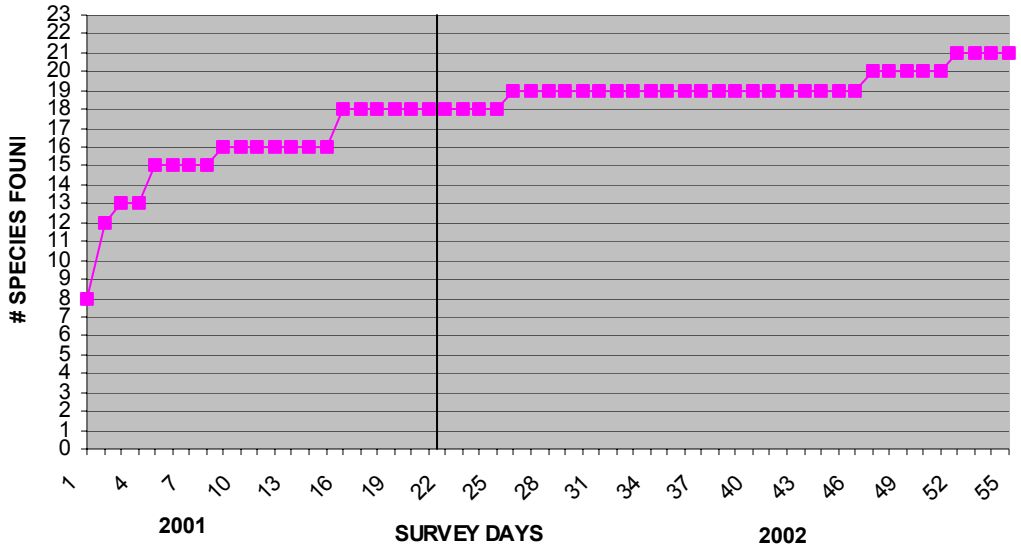
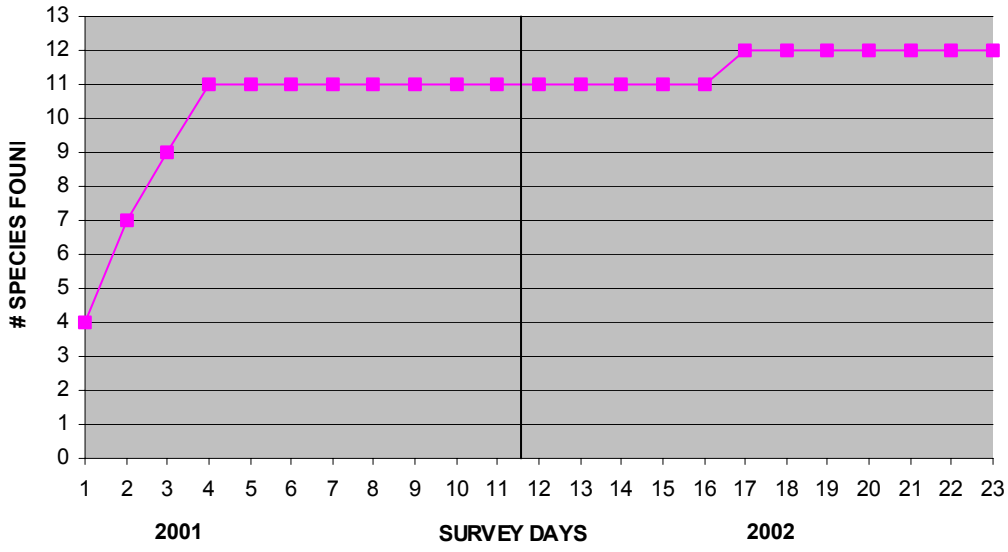



**Figure 2l. 2001 AND 2002 YUHO SPECIES ACCUMULATION (all methods combined)**



When the three parks surveyed only in 2002 are examined, two patterns emerge. First, we have not yet approached detection of 90% of the species at those parks- the curves have not yet reached asymptotes. Secondly, as reported earlier for 2001 data and as shown in 2002, the general survey method produced more species at faster rates than randomly-generated plots (with the exception of ELMA, where comparatively little time was spent on general surveys). Of the random plots, area unbounded 10-ha plots had better species detection rates than 1-ha area bounded plots.

It is obvious from examining the accumulation graphs for parks surveyed in both 2001 and 2002 that species accumulation rates slowed down by the end of the first season, dramatically for some, e.g. WACA and YUHO. While the rates of accumulation increased slightly for most parks in 2002 over 2001 totals, for two parks (AZRU and SUCR), no further species accumulation occurred in 2002.

Because estimated inventory completeness is overall only 69%, and is in only three parks at or above 80%, the asymptotic nature of the species accumulation curve for many parks (e.g. AZRU, YUHO, and SUCR) is misleading: we are in fact not very close to detecting 90% of the species at most parks. This false asymptote tells us only that we are close to detecting most of the common species using our current methods. Our methods have been heavily weighted toward daytime surveys, particularly randomly-generated plot searches. Our methods thus far have largely been daytime surveys, particularly random plot searches. While random 1- and 10-ha TACS provide a basis for statistical comparison among parks or habitats, they primarily detect only diurnal lizards, a group of species easily found by general surveying or VES methods.

One of the most important factors in reducing success in both 2001 and 2002 was the relative unavailability of night driving as a method for detecting amphibians and snakes. Most areas surveyed have few paved roads (exceptions are CHCU, ELMA, and WUPA). However, the facts that it did not rain very much at the northern parks (YUHO and HOVE) in 2001 and that 2002 was one of the worst drought years on record throughout the southwest did not help our efforts any, either. Common amphibian species were likely unrecorded at many parks due to dry conditions, and monsoon season snake activity was likely depressed as well.

Perhaps even more important in determining our accumulation of species overall was the limited amount of time available to us to spend on inventories in any given park. When a variety of field methods are used over a long span of time, species accumulation curves can give a reliable estimate of degree of inventory completeness, i.e., a strongly asymptotic curve suggests that you are at or near 100% completeness (Scott 1994). In a two-year amphibian and reptile inventory at Petrified Forest National Park, where researchers were based at the park during the entire active season, Drost et al. (1999) plotted a strongly asymptotic species accumulation curve, and comparison with master lists of expected species produced an estimated inventory completeness of >90%. This high success rate was due to the combination of field methods that adequately sampled across taxa. In particular, nighttime road driving was extremely effective at sampling amphibian and snakes, including many species not detected by any other method.

## LITERATURE REVIEW AND MUSEUM SEARCHES

We have drawn on a number of sources in compiling our list (Appendix E) of species expected to occur at each park (e.g. Bateman 1976, 1980, Bury 1977, Davenport 1998, Degenhardt 1975, Degenhardt et al. 1996, Fowlie 1965, Gehlbach 1965, Hammerson 1999, Harris 1963, Jones 1970, Lightfoot et al. 1994, Parmenter et al. 1996, Persons 1999, 2001, Persons and Bradley 2000, Scott 1979, Stebbins 1985). In addition, we have reviewed many park species lists and natural history observation cards. Although these seldom have associated documentation (e.g., photographs) that would allow us to accept a record as proof of occurrence, they frequently alert us to the possibility or probability of a species occurring in a particular park. For example, a species list for HOVE (Rado 1975) lists Smooth Green Snake as occurring in the monument. Due to marginal habitat, we would not *a priori* expect this species to occur at HOVE, but because this list is otherwise sound we must consider it as a real possibility.

Thorough museum searches will be conducted throughout the study period, and every effort will be made to locate specimens of species that remain undocumented by us at the end of each park's field inventory. Although fragmentary, knowledge of selected museum collection holdings (e.g. Museum of Northern Arizona, University of Arizona, Flagstaff Area National Monuments) has helped us in constructing our preliminary lists of hypothetical species at many parks (Appendix E). For parks in New Mexico and Colorado, we will rely heavily on excellent, recent books (Degenhardt et al. 1996, Hammerson 1999) which include data from specimens from virtually every major U.S. museum with holdings from those states.

## SPECIMENS COLLECTED

We collected 49 amphibian and reptile specimens in 2002 at the twelve SCP park areas surveyed (including HOVE). A complete list of these specimens is found in Appendix F. Upon completion of the inventories, these and all other specimens collected as part of this study will be deposited primarily in the herpetological collections at the Museum of Southwestern Biology (MSB), University of New Mexico, and will be assigned both MSB and National Park Service (ANCS+) catalog numbers. Some of the specimens collected from SUCR, WACA, and WUPA will be deposited in the Flagstaff Area National Monuments vertebrate collection.

## RECOMMENDATIONS FOR FUTURE INVENTORY WORK

Clearly, given an overall estimated inventory completeness of only 69% and a trend in many parks of slowing of species accumulation over time, reaching the goal of 90% inventory completeness at the end of one or two years seems unrealistic without a shift in methodology and/or a substantial increase in the amount of time spent. Although random plots have advantages for performing replicable statistical analyses, they are not a cost-effective means of conducting complete species inventories, especially using stratification criteria that are not suitable for herpetofauna (as in the present inventories). Although a large enough dataset based upon randomly-located plots may theoretically be able to generate a statistically valid estimate of

how complete a species inventory is (e.g. Burnham and Overton 1979), such an approach will likely not document many uncommon or rare species. In addition, the necessary statistical condition of equal detectability of species is clearly strongly violated in surveys of amphibians and reptiles, many species of which are secretive and rarely seen, often despite their true great abundance. It is well known that general (non random) herpetological collecting techniques are far superior if compilation of a species list is the primary goal of a project (e.g. Campbell and Christman 1982, Scott 1994). With that in mind, our recommendations for conducting fieldwork in 2003 and beyond follow.

**Minimize sampling time at 10-ha random time constrained search plots and abandon 1-ha time-area constrained searches**. One-hectare plots are clearly unsuitable for detecting rare and/or nocturnal herpetofauna species. Random plots, which primarily detect diurnal lizards, take a large amount of field time (locating and establishing boundaries of plots, surveying for animals, and recording of habitat data), and are unlikely to produce many new species. In addition, because most plots were conducted during peak morning lizard activity times, the brief morning window of maximum lizard activity is generally used up conducting a single survey. In order to maximize our chances of finding new species, peak activity times should be spent searching for animals across a variety of habitats. If meeting statistical criteria with randomly-generated plots is seen as critical to the overall inventory, then some 10-ha TACS (functionally area-unbounded) plots may be kept. However, they should only be sampled in proportion to other methods (general surveys, night driving, and/or nocturnal general surveys), not used as the primary method.

**Conduct targeted searches for uncommon species.** A general knowledge of the distribution and abundance of the more common amphibian and reptile species, (identified as a secondary goal of these inventories) comes naturally as a byproduct of fieldwork, regardless of the specific methods employed. To realistically attempt an inventory completeness of 90%, most sampling effort in 2003 should be directed towards locating uncommon or secretive species not yet detected. In particular, targeted searches should be conducted for amphibians, especially in early spring for spring-breeding species (e.g. Striped Chorus Frog) and during the summer monsoon season, when many true toads and spadefoot toads breed explosively. The largest number of undetected species are snakes, and to find them more general surveys should be conducted during optimum activity times (often evening, especially after the onset of summer monsoon rains in July and August). At other times of the day, likely microhabitats (e.g. under rocks and logs) where animals may be resting should be targeted. Where possible, night driving should also be continued during the monsoon season.

**Increase involvement of National Park Service staff and volunteers.** Observations and/or collections by Park Service staff can be invaluable in an inventory effort such as this, especially for uncommon or secretive species that are generally undetected during periodic, short duration visits to the parks. Now that baseline data exists on species occurrence in most parks, help of interested staff and volunteers can more easily be solicited by distributing “want lists” of species still undetected, along with instructions on salvaging road killed animals and even capturing live animals and holding them until they could be picked up by researchers.

Observation cards held at park units have been very helpful in highlighting appropriate survey locations, but these frequently date back pre-1980's. It is recommended that all parks units be supplied with observation cards and staff encouraged to use them. We could provide training in species identification if desired.

**Future inventory work**. We strongly recommend further inventory work at parks with inventory completeness of less than 60%, i.e. AZRU, PETR, WACA, and SUCR. As previously mentioned, a prime determinant of inventory completeness is the amount of time spent sampling at the park. The highest inventory completeness for SCP parks for herpetofauna is at WUPA, at 92%. This is an area which has been intensively sampled (has the highest number of survey days) due to its proximity to Flagstaff where we are based, and it has been sampled often over the past four years in conjunction with other herpetological research occurring there (Persons 2001, 2002). We expect the inventory completeness for other areas would quickly approach 90% (with the possible exception of SUCR given its cold climate) if similar amounts of time were invested in them. This certainly has been the case for intensive herpetological inventories at Montezuma Castle National Monument (Drost and Nowak 1997) and Petrified Forest National Park (Drost et al. 2001). Frankly, we would recommend such surveys being conducted by knowledgeable herpetologists who either live close to the park and/or who can stay in park housing for two seasons. We would also recommend that the researchers retain association with the parks for more than two years so that new sightings made by park staff or by other researchers can be reported, vouchered, and verified.

## RECOMMENDATIONS FOR LONG TERM MONITORING

Although our inventories are not yet complete, a few ideas are worth mentioning at this point. Clearly, more work is needed at most parks in order to reach a satisfactory level of inventory completeness, which ideally would precede serious long term monitoring efforts. One compromise approach could be to conduct periodic (e.g. every ten years) complete species inventories (D. Swann, Saguaro National Park, pers. comm.), which would aid in the ultimate goal of completion or near completion of species lists, and simultaneously serve as a general monitoring of overall diversity.

It is also clear from our preliminary data from 2001-2002 that monitoring of uncommon or rare species, which are often of interest as potential "vital signs" of ecosystem health, will be extremely difficult in most cases, simply because they are so difficult to locate at all. Instead, monitoring should focus on common species or groups of species (e.g., diurnal lizards). An exception would probably be small, highly localized populations of some amphibian species or known amphibian breeding areas (e.g. stock ponds at YUHO, tinajas used by Canyon Treefrogs at WACA).

Based on the data from 2001-2002, random plot searches are not a very effective means of detecting large numbers of individuals across taxa, and are therefore not an ideal method for long term monitoring of diversity. They may have some limited value in monitoring common diurnal lizard species, especially if they are area-unbounded (10-ha TACS). Random plots may have more widespread utility if the stratification criteria focus on features important to herpetofauna,

but the success of this method will need to be tested in relation to other methods before we would endorse it.

Rigorous transect-based monitoring of lizard communities has been underway at Organ Pipe Cactus National Monument (ORPI) for over a decade (Rosen and Lowe 1996), and such a method may be applicable to areas on the Colorado Plateau as well where lizard population densities are high (e.g. PETR and BAND). As part of a separate study of the Red-backed Whiptail in southern Arizona (Rosen et al. 2002), additional lizard line transects were established at ORPI. However, in an effort to detect greater numbers of lizards, and facilitate fieldwork in steep, rocky terrain, transects simply utilized existing backcountry hiking trails. Although not random, such transects would be easy to establish, convenient to run, and could be relatively long, providing large enough sample sizes for statistically sound interannual, seasonal, or other comparisons. Examples of potential transects in SCP parks could include the Frijoles Canyon trail at BAND or the Rinconada Canyon loop trail at PETR. Based on our work at BAND, it appears that Tree Lizards have decreased dramatically throughout the monument since previous surveys in the 1970's (Degenhardt 1975), including along Frijoles Creek, where we did not detect them at all in 2002. If such a lizard survey transect had been established in the 1970's along Frijoles Creek, we would now have valuable data with which to study the decline of Tree Lizards, and could analyze that data with respect to both external (e.g. climatic) and internal park conditions over that time.

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**Appendix A.** Data form used in 2002 (following two pages) for herpetofauna TACS 1-ha and 10-ha plots in the Southern Colorado Plateau I&M Network. There are two pages, meant to be photocopied back to back.

**Park Code** _____ **Pg.** ____ **of** ____

## Southern Colorado Plateau Herpetofauna Surveys

**Date** _____ **Observers** _____ **Location** _____

**GPS Unit** _____ **Datum / Zone** _____ **Survey Type (circle):** **1 Ha TACS Plot** **~10 Ha TCS survey**

**UTMs: Easting** _____ **Northing** _____ **EPE** _____

**Elevation** _____ **USGS Quad** _____ **Slope** _____ **Aspect** _____

**Description of Plot** _____

_____

**Photo #s** _____ **Description of Photo Shots** _____

**Landform Class** _____ **Soil Type** _____ **Surface Water Type** _____

| Cover Stratum | Species | % Cover | Height |
|---|---|---|---|
| **Tree Total %** | | | |
| | | | |
| | | | |
| | | | |
| **Shrub Total %** | | | |
| | | | |
| | | | |
| | | | |
| **Herbaceous Total %** | | | |
| | | | |
| | | | |
| | | | |
| **Unvegetated Total %** | **Bedrock** | | |
| | **Large Rocks ( >10 cm)** | | |
| | **Small Rocks ( 0.2 - 10 cm)** | | |
| | **Sand / Bare Soil** | | |
| | **Litter / Duff** | | |
| | **Woody Debris ( > 1 cm)** | | |
| | **Biotic Crust** | | |

**Park Code** _____ **Pg.** _____ **of** _____

## Southern Colorado Plateau Herpetofauna Surveys

**Date** _____ **Observers** _____ **Location** _____

| | Time | % Cloud Cover | Sun Condition | Ta °C | Ts °C | Wind Max. (mph) | Wind Avg. (mph) | rH % |
|---|---|---|---|---|---|---|---|---|
| **Begin** | | | | | | | | |
| **End** | | | | | | | | |

### HERPETOFAUNA OBSERVATIONS

| Species | Time | Sex | Age Class | Notes |
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**Notes** _____

**Appendix B.** Amphibians and reptiles detected at twelve national parks and monuments on the Southern Colorado Plateau during herpetological surveys in 2002.

**Amphibians**

Tiger Salamander *(Ambystoma tigrinum*)
Great Plains Toad (*Bufo cognatus*)
Red-spotted Toad (*Bufo punctatus*)
Woodhouse's Toad (*Bufo woodhousii)*
Canyon Treefrog (*Hyla arenicolor*)
Plains Spadefoot (*Spea bombifrons*)
New Mexico Spadefoot (*Spea multiplicata*)
Bullfrog (*Rana catesbeiana*)

**Lizards**

Common Collared Lizard (*Crotaphytus collaris*)
Longnose Leopard Lizard (*Gambelia wislizenii*)
Lesser Earless Lizard (*Holbrookia maculata*)
Short-horned Lizard (*Phrynosoma douglassii*)
Sagebrush Lizard (*Sceloporus graciosus*)
Desert Spiny Lizard (*Sceloporus magister*)
Eastern Fence Lizard (*Sceloporus undulatus*)
Tree Lizard (*Urosaurus ornatus*)
Side-blotched Lizard (*Uta stansburiana*)
Many-lined Skink (*Eumeces multivirgatus*)
Great Plains Skink (*Eumeces obsoletus*)
Chihuahuan Spotted Whiptail (*Cnemidophorus exsanguis*)
Little Striped Whiptail (*Cnemidophorus inornatus*)
New Mexican Whiptail (*Cnemidophorus neomexicanus*)
Western Whiptail (*Cnemidophorus tigris*)
Plateau Striped Whiptail (*Cnemidophorus velox*)
Western Banded Gecko (*Coleonyx variegatus*)

**Snakes**

Night Snake (*Hypsiglena torquata*)
Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*)
Coachwhip (*Masticophis flagellum*)
Striped Whipsnake (*Masticophis taeniatus*)
Gopher Snake (*Pituphis catenifer*)
Graham Patchnose Snake (*Salvadora grahamiis*)
Western Patchnose Snake (*Salvadora hexalepis*)
Western Terrestrial Garter Snake (*Thamnophis elegans*)
Lined Snake (*Tropidoclonion lineatum*)
Western Diamondback Rattlesnake (*Crotalus atrox*)
Western Rattlesnake (*Crotalus viridis*)
Texas Blind Snake (*Leptotyphlops dulcis*)

**Appendix C. Individual Park Accounts of Species Detected**.

The following twelve individual park accounts contain summaries of our findings, number of individuals and species detected by different methods, estimated inventory completeness after the first year of fieldwork (BAND, CHCU, ELMA), or two years of fieldwork (other nine parks) and notes on new species, rare species, or other species of special interest. In addition, we briefly summarize where effort will be directed in 2003 in order to complete our species inventories.

### a. Aztec Ruins National Monument (AZRU)

Between our surveys at AZRU in 2001-2002 and previously documented species (Table a1), we estimate an inventory completeness of 54% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table a1.** Amphibian and reptile species documented for AZRU. An asterisk (*) denotes a species represented by a voucher specimen.

| |
|---|
| *Woodhouse's Toad |
| *Striped Chorus Frog |
| *Common Collared Lizard |
| *Sagebrush Lizard |
| *Eastern Fence Lizard |
| *Western Whiptail |
| *Plateau Striped Whiptail |
| Striped Whipsnake |
| Gopher Snake |
| *Western Terrestrial Garter Snake |
| Western Rattlesnake |

Table a2 shows the number of species and individuals detected by each method at the park in 2002.

**Table a2.** Number of individuals and species detected by different methods at AZRU in 2002. An "X" in a column indicates that the method was not used at that park.

| AZRU | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | X | X | 8 | 7 | 0 | 4 | **19** |
| Species | X | X | 2 | 2 | 0 | 1 | **2** |
| **Lizards** | | | | | | | |
| Individuals | X | X | 62 | 0 | 0 | 7 | **69** |
| Species | X | X | 4 | 0 | 0 | 2 | **4** |
| **Snakes** | | | | | | | |
| Individuals | X | X | 8 | 0 | 0 | 6 | **14** |
| Species | X | X | 2 | 0 | 0 | 3 | **3** |
| **Total** | | | | | | | |
| **Individuals** | **X** | **X** | **78** | **7** | **0** | **17** | **102** |
| **Species** | **X** | **X** | **8** | **2** | **0** | **6** | **9** |

We found no new species in our surveys of AZRU in 2002, largely due to the severe drought conditions which affected much of the southwest in 2002. We still expect AZRU to have a fairly diverse herpetofauna for its small size, based on the diversity of habitats found in the monument. In particular, the recently added undisturbed uplands north of the main irrigation ditch likely harbor a number of snake species (e.g., Night Snake, Hognose Snake, Common Kingsnake, Glossy Snake) not yet found by us. This is also the only area in the monument where we observed Common Collared Lizards and Western Whiptails. In 2002 we collected additional specimens of the all-female Plateau Striped Whiptail, which appears to be represented at AZRU by two distinct morphological types. It is possible that these two morphological types represent two distinct species of separate hybrid origin. Our estimation of inventory completeness has been increased due to better evaluation of the AZRU herpetofauna after two years of surveys, in particular some species (e.g. Side-blotched Lizard, Tree Lizard) originally thought to occur have been downgraded, as it is highly improbable we would have missed these conspicuous, diurnal species.

## b. Bandelier National Monument (BAND)

Between our surveys at BAND in 2002 and previously documented species (Table b1), we estimate an inventory completeness of 68% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table b1.** Amphibian and reptile species documented for BAND. An asterisk (*) denotes a species represented by a voucher specimen.

*Tiger Salamander
Jemez Mountains Salamander
Red-spotted Toad
Woodhouse's Toad
*Canyon Treefrog
Striped Chorus Frog
Bullfrog
*Common Collared Lizard
*Short-horned LIzard
Eastern Fence Lizard
Tree Lizard
*Many-lined Skink
Great Plains Skink
*Chihuahuan Spotted Whiptail
*Checkered Whiptail
*Plateau Striped Whiptail
*Ringneck Snake
Striped Whipsnake
*Gopher Snake
Graham Patchnose Snake
Western Terrestrial Garter Snake
Western Diamondback Rattlesnake

Table b2 shows the number of species and individuals detected by each method at the park in 2002.

**Table b2.** Number of individuals and species detected by different methods at BAND in 2002.

| BAND | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 0 | 40 | 10 | 0 | 0 | **50** |
| Species | 0 | 0 | 3 | 2 | 0 | 0 | **3** |
| **Lizards** | | | | | | | |
| Individuals | 21 | 3 | 218 | 1 | 0 | 12 | **255** |
| Species | 3 | 1 | 8 | 1 | 0 | 2 | **9** |
| **Snakes** | | | | | | | |
| Individuals | 0 | 0 | 22 | 3 | 0 | 3 | **28** |
| Species | 0 | 0 | 4 | 2 | 0 | 1 | **5** |
| **Total** | | | | | | | |
| **Individuals** | **21** | **3** | **280** | **14** | **0** | **15** | **333** |
| **Species** | **3** | **1** | **15** | **5** | **0** | **3** | **17** |

Based on previous surveys (Degenhardt 1975), we found one new species (Graham Patchnose Snake) at BAND in 2002. This species was expected to occur in the monument (Degenhardt 1975). The New Mexico Whiptail, another expected species (Degenhardt 1975), was possibly observed along the Rio Grande, but because a specimen was not secured, identification remains uncertain. The most interesting result of our surveys was the rarity of the Tree Lizard, a species described as abundant and widespread by Degenhardt (1975). In particular, Degenhardt (1975) listed Frijoles Canyon among occupied areas, and we found no Tree Lizards there, despite numerous surveys specifically looking for them. In addition, the habitat appears ideal for them (semipermanent water, large boulders), but we only detected Eastern Fence Lizards. At this point, we can only speculate on why Tree Lizards have declined at BAND. In 2003, we will continue random 10-ha TACS plot surveys, and we will conduct targeted searches, particularly for snakes in the lower canyons. In addition (pending resolution of permit delays), we will focus on collecting voucher specimens of species not previously documented, after review of specimens at the Museum of Southwestern Biology.

### c. Chaco Culture National Historic Site (CHCU)

Between our surveys at CHCU in 2002 and previously documented species (Table c1), we estimate an inventory completeness of 77% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table c1.** Amphibian and reptile species documented for CHCU. An asterisk (*) denotes a species represented by a voucher specimen.

*Tiger Salamander
*Plains Spadefoot
*New Mexico Spadefoot
*Common Collared Lizard
*Lesser Earless Lizard
*Short-horned Lizard
*Sagebrush Lizard
*Eastern Fence Lizard
*Tree Lizard
*Side-blotched Lizard
*Plateau Striped Whiptail
*Night Snake
*Striped Whipsnake
*Gopher Snake
*Western Terrestrial Garter Snake
*Western Rattlesnake

Table c2 shows the number of species and individuals detected by each method at the park in 2002.

**Table c2.** Number of individuals and species detected by different methods at CHCU in 2002.

| CHCU | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 0 | larvae | 0 | 32 | 0 | **32** |
| Species | 0 | 0 | 1 | 0 | 2 | 0 | **2** |
| **Lizards** | | | | | | | |
| Individuals | 14 | 29 | 135 | 1 | 1 | 4 | **184** |
| Species | 3 | 4 | 6 | 1 | 1 | 3 | **7** |
| **Snakes** | | | | | | | |
| Individuals | 1 | 1 | 3 | 0 | 8 | 3 | **16** |
| Species | 1 | 1 | 2 | 0 | 4 | 1 | **4** |
| **Total** | | | | | | | |
| **Individuals** | **15** | **30** | **138** | **1** | **41** | **7** | **232** |
| **Species** | **4** | **5** | **9** | **1** | **7** | **4** | **13** |

Based on previous surveys (Jones 1970), we documented two new species (Night Snake, Western Terrestrial Garter Snake) at CHCU in 2002. Both of these species were expected to occur at CHCU. The Garter Snake had been found nearby, but outside of, the monument by Jones (1970), and the Night Snake is a ubiquitous species on the Colorado Plateau and elsewhere, but is secretive and strictly nocturnal, and we were not surprised to only find this species by nighttime road cruising. Although both Red-spotted and Woodhouse's toads are expected to occur, we, like Jones (1970), detected only spadefoots in 2002. However, former CHCU Resource Management Specialist Paul Whitefield (personal communication) believes he may have heard Woodhouse's Toads there, so we will focus some of our 2003 efforts on locating this species. We will also, in addition to continuation of random plot surveys, conduct more nighttime road cruising surveys (snakes, toads) and targeted daytime searches of sandy grasslands for species such as Hognose Snake and Little Striped Whiptail

## d. El Malpais National Monument (ELMA)

Between our surveys at ELMA in 2002 and previously documented species (Table d1), we estimate an inventory completeness of 80% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table d1.** Amphibian and reptile species documented for ELMA. An asterisk (*) denotes a species represented by a voucher specimen.

| |
|---|
| Tiger Salamander |
| Canyon Treefrog |
| *Plains Spadefoot |
| *New Mexico Spadefoot |
| Common Collared Lizard |
| Lesser Earless Lizard |
| Short-horned Lizard |
| Eastern Fence Lizard |
| Tree Lizard |
| Many-lined Skink |
| Great Plains Skink |
| Chihuahuan Spotted Whiptail? (questionable record) |
| *Plateau Striped Whiptail |
| Striped Whipsnake |
| Gopher Snake |
| Western Terrestrial Garter Snake |
| Western Diamondback Rattlesnake |
| Western Rattlesnake |

Table d2 shows the number of species and individuals detected by each method at the park in 2002.

**Table d2.** Number of individuals and species detected by different methods at ELMA in 2002.

| ELMA | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 1 | 0 | 0 | 10 | 1 | **12** |
| Species | 0 | 1 | 0 | 0 | 2 | 1 | **2** |
| **Lizards** | | | | | | | |
| Individuals | 38 | 40 | 42 | 0 | 0 | 4 | **124** |
| Species | 2 | 5 | 4 | 0 | 0 | 3 | **7** |
| **Snakes** | | | | | | | |
| Individuals | 0 | 0 | 1 | 0 | 4 | 1 | **6** |
| Species | 0 | 0 | 1 | 0 | 2 | 1 | **3** |
| **Total** | | | | | | | |
| **Individuals** | **38** | **41** | **43** | **0** | **14** | **6** | **142** |
| **Species** | **2** | **6** | **5** | **0** | **4** | **5** | **12** |

Based on previous surveys (Lightfoot et al. 1994), we documented one new species (Plains Spadefoot) at ELMA in 2002. Although ELMA contains an ideal road driving transect (SR 117, along the eastern boundary), we found few species on nighttime surveys there, mostly attributable to the severe drought experienced at ELMA and throughout the southwest in 2002. Many of the species reported by Lightfoot et al. (1994) are represented by specimens in the Museum of Southwestern Biology, but we are awaiting review of those specimens (verification of species identification) before including them as vouchered (*) in Table X. In particular, Lightfoot et al. (1994) report Chihuahuan Spotted Whiptail, which would be a significant range extension. It is possible they may have misidentified a Plateau Striped Whiptail, of which at least two morphological types are found at ELMA, likely representing two distinct species of separate hybrid origin. One of these morphotypes can be somewhat spotted, a feature characteristic of Chihuahuan Spotted Whiptails, but not of most Plateau Striped Whiptails. Aside from continuation of random plot surveys, and road driving surveys for snakes (Table 3), better resolution of whiptail lizard species occurrence and distribution will be a top priority for fieldwork at ELMA in 2003.

## e. El Morro National Monument (ELMO)

Between our surveys at ELMO in 2001-2002 and previously documented species (Table e1), we estimate an inventory completeness of 83% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table e1.** Amphibian and reptile species documented for ELMO. An asterisk (*) denotes a species represented by a voucher specimen.

*Tiger Salamander
*Plains Spadefoot
*New Mexico Spadefoot
*Eastern Fence Lizard
*Tree Lizard
Short-horned Lizard
Many-lined Skink
Plateau Striped Whiptail
*Night Snake
Milk Snake
*Gopher Snake
*Western Terrestrial Garter Snake
*Western Rattlesnake

Table e2 shows the number of species and individuals detected by each method at the park in 2002.

**Table e2**. Number of individuals and species detected by different methods at ELMO in 2002.

| ELMO | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 2 | 7 | 18 | 7 | 0 | **34** |
| Species | 0 | 1 | 1 | 1 | 3 | 0 | **3** |
| **Lizards** | | | | | | | |
| Individuals | 35 | 30 | 77 | 0 | 0 | 20 | **162** |
| Species | 2 | 2 | 3 | 0 | 0 | 4 | **4** |
| **Snakes** | | | | | | | |
| Individuals | 1 | 0 | 2 | 0 | 8 | 2 | **13** |
| Species | 1 | 0 | 1 | 0 | 3 | 2 | **3** |
| **Total** | | | | | | | |
| **Individuals** | **36** | **32** | **86** | **18** | **15** | **22** | **209** |
| **Species** | **3** | **3** | **5** | **1** | **6** | **6** | **10** |

Despite discontinuation of fieldwork midway through the 2001 season, we were able in 2002 to finish our random plot surveys at ELMO, in addition to conducting limited general surveying and nighttime road cruising surveys. We only found two new species (Night Snake and Short-horned lizard) at ELMO in 2002, but our current evaluation of inventory completeness is significantly increased due to the inclusion of museum specimen records reported by Gehlbach (1965). In addition, we have included Milk Snake, which although unvouchered by a specimen, is represented by a reliable sight record (Degenhardt et al. 1996). Although observed by us, we were unable to secure specimens of Many-lined Skink, Short-horned Lizard and Plateau Striped Whiptail, and we will attempt to do so in Spring of 2003. All other species possibly expected to occur at ELMO (Table 3) will require opportunistic collecting by NPS staff or other researchers in years to come.

## f. Hovenweep National Monument (HOVE)

Between our surveys at HOVE in 2001-2002 and previously documented species (Table f1), we estimate an inventory completeness of 69% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table f1.** Amphibian and reptile species documented for HOVE. An asterisk (*) denotes a species represented by a voucher specimen. Locations in parentheses indicate park units where the species has been observed: ST=Square Tower unit, H&H=Hackberry & Horseshoe unit, HOL=Holly unit, CC=Cutthroat Castle unit, CAJ=Cajon unit, and GP=Goodman Point unit.

*Tiger Salamander (H&H)
*Red-spotted Toad (ST)
Woodhouse's Toad (ST)
*New Mexico Spadefoot (ST)
*Common Collared Lizard (ST, CC, CAJ)
*Longnose Leopard Lizard (ST, CAJ)
*Sagebrush Lizard (ST, GP)
*Desert Spiny Lizard (HOL, CAJ)
*Eastern Fence Lizard (all six units)
*Side-blotched Lizard (ST, H&H, CC, CAJ)
*Tree Lizard (ST, H&H, HOL, CC, CAJ)
*Western Whiptail (ST, HOL, CC, CAJ)
Common Kingsnake
Striped Whipsnake (ST)
*Gopher Snake (ST)
Western Rattlesnake (ST)

Table f2 shows the number of species and individuals detected by each method at the park in 2002.

**Table f2**. Number of individuals and species detected by different methods at HOVE in 2002. An "X" in a column indicates that the method was not used at the park.

| HOVE | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | X | X | 5 + eggs | 10 | 43 | 1 | **59** |
| Species | X | X | 2 | 2 | 3 | 1 | **4** |
| **Lizards** | | | | | | | |
| Individuals | X | X | 229 | 0 | 8 | 7 | **244** |
| Species | X | X | 8 | 0 | 5 | 5 | **8** |
| **Snakes** | | | | | | | |
| Individuals | X | X | 1 | 0 | 0 | 0 | **1** |
| Species | X | X | 1 | 0 | 0 | 0 | **1** |
| **Total** | | | | | | | |
| **Individuals** | **X** | **X** | **235** | **10** | **51** | **8** | **304** |
| **Species** | **X** | **X** | **11** | **2** | **8** | **6** | **13** |

Although we did not find any new species at HOVE in 2002 based on previous species lists (Rado 1975), we did find three amphibian species (New Mexico Spadefoot, Red-spotted Toad, and Woodhouse's Toad) that we did not observe in 2001. In addition, we located a series of specimens, now at the California Academy of Sciences, collected by the NPS in the 1970's, but it contained only common species already documented by us. Four species (Smooth Green Snake, Glossy Snake, Milk Snake, and Common Kingsnake) reported by Rado (1975) have not been found by us. We have included Common Kingsnake on the current species list because it was apparently photographed eating a Gopher Snake within the Hovenweep House Ruin, and species identity was verified by Ted Rado (personal communication). However, the other three snake species listed were observed by others, and unless photographs or specimens emerge, we must consider them hypothetical. Glossy Snake undoubtedly occurs, as we observed a road-killed specimen in 2001 less than a mile from the Cajon unit, and Milk Snakelikewise seems probable. However, it seems hard to imagine a population Smooth Green Snake at HOVE. The single record was reported from the head of Ruin Canyon (Rado 1975, and personal communication), which seems much too xeric for this species, which elsewhere in southeastern Utah is found in mesic foothill and mountain wet meadow habitats (Cox and Tanner 1995). Any efforts in 2003 will focus on finding and vouchering these and other (e.g. Night Snake, Striped Whipsnake) snake species.

## g. Petroglyph National Monument (PETR)

Between our surveys at PETR in 2001-2002 and previously documented species (Table g1), we estimate an inventory completeness of 49% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table g1.** Amphibian and reptile species documented for PETR. An asterisk (*) denotes a species represented by a voucher specimen.

| |
|---|
| New Mexico Spadefoot |
| Common Collared Lizard |
| Longnose Leopard Lizard |
| Lesser Earless Lizard |
| Short-horned Lizard |
| *Roundtail Horned Lizard |
| *Eastern Fence Lizard |
| *Side-blotched Lizard |
| *Great Plains Skink |
| *Little Striped Whiptail |
| New Mexican Whiptail |
| *Ringneck Snake |
| Coachwhip |
| *Striped Whipsnake |
| Long-nosed Snake |
| Western Diamondback Rattlesnake |
| Western Rattlesnake |
| *Texas Blind Snake |

Table g2 shows the number of species and individuals detected by each method at the park in 2002.

**Table g2**. Number of individuals and species detected by different methods at PETR in 2002. An "X" in a column indicates that the method was not used at the park.

| PETR | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 0 | 0 | 0 | X | 0 | **0** |
| Species | 0 | 0 | 0 | 0 | X | 0 | **0** |
| **Lizards** | | | | | | | |
| Individuals | 6 | 75 | 93 | 0 | X | 32 | **206** |
| Species | 2 | 6 | 6 | 0 | X | 4 | **7** |
| **Snakes** | | | | | | | |
| Individuals | 0 | 3 | 5 | 0 | X | 1 | **9** |
| Species | 0 | 2 | 3 | 0 | X | 1 | **4** |
| **Total** | | | | | | | |
| **Individuals** | **6** | **78** | **98** | **0** | **X** | **33** | **215** |
| **Species** | **2** | **8** | **9** | **0** | **X** | **5** | **11** |

The only new species found at PETR in 2002 was a Texas Blind Snake, which was found by Rich Anderson while conducting a field ecology class in Rinconada Canyon. Although probably abundant at PETR, this species is rarely surface active. We finished our random plot surveys in 2002, which produced no new species, in part because 2002 was an extremely dry year, being among the worst drought years on record. Although inventory completeness estimates remain low for PETR, this will hopefully change when we review specimens at the Museum of Southwestern Biology (MSB). Parmenter et al. (1996) reported many species not on our above list based on specimens at MSB, but they included records from a much wider area ("West Mesa"), and examination of detailed locality data will be necessary to sort out those that came from within the current boundaries of PETR. Inventory completeness could be increased also if the small, disjunct, jointly managed property near the Rio Grande were not included. Many hypothetical species from Appendix E (the four aquatic turtles, all four garter snakes, Tree Lizard, and Chihuahuan Spotted Whiptail) likely only occur there. Political disputes and scheduling problems have reduced our survey time at this property (part of one day), and hopefully we can arrange at least one additional survey there in 2003, at a minimum to attempt to document diurnal lizard species.

## h. Salinas Pueblo Missions National Monument (SAPU)

Between our surveys at SAPU in 2001-2002 and previously documented species (Table h1), we estimate an inventory completeness of 70% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table h1.** Amphibian and reptile species documented for SAPU. An asterisk (*) denotes a species represented by a voucher specimen. Locations in parentheses indicate park units in which each species has been observed, and collected(*).

*Tiger Salamander (*Abo)
*New Mexico Spadefoot (*Abo)
*Plains Spadefoot (Gran Quivira, *Quarai)
*Red-spotted Toad (*Abo)
Woodhouse's Toad (Quarai)
*Common Collared Lizard (*Abo, Quarai)
Lesser Earless Lizard (Gran Quivira)
*Roundtail Horned Lizard (*Abo)
*Eastern Fence Lizard (*Abo, *Gran Quivira, *Quarai)
*Tree Lizard (*Abo)
*Great Plains Skink (*Quarai)
*Little Striped Whiptail (Abo, *Gran Quivira)
*Chihuahuan Spotted Whiptail (*Abo, Quarai)
*Night Snake (*Abo, *Gran Quivira)
*Glossy Snake (*Gran Quivira)
*Striped Whipsnake (*Gran Quivira)
*Gopher Snake (*Gran Quivira, Quarai)
*Black-necked Garter Snake (*Abo)
*Lined Snake (*Quarai)
*Western Terrestrial Garter Snake (Abo, *Quarai)
Western Diamondback Rattlesnake (Abo, Gran Quivira)
Western Rattlesnake (Gran Quivira)

Table h2 shows the number of species and individuals detected by each method at the park in 2002.

**Table h2**. Number of individuals and species detected by different methods at SAPU in 2002. An "X" in a column indicates that the method was not used at the park.

| SAPU | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | X | X | 2 | 17 | 18 | 0 | **37** |
| Species | X | X | 2 | 1 | 2 | 0 | **3** |
| **Lizards** | | | | | | | |
| Individuals | X | X | 155 | 0 | 1 | 4 | **159** |
| Species | X | X | 7 | 0 | 1 | 3 | **7** |
| **Snakes** | | | | | | | |
| Individuals | X | X | 13 | 1 | 8 | 1 | **23** |
| Species | X | X | 5 | 1 | 4 | 1 | **8** |
| **Total** | | | | | | | |
| **Individuals** | **X** | **X** | **170** | **18** | **26** | **5** | **219** |
| **Species** | **X** | **X** | **17** | **2** | **6** | **4** | **18** |

We documented three new species at SAPU in 2002: Great Plains Skink at Quarai, Night Snake at both Abo and Gran Quivira, and Lined Snake at Quarai. The Lined Snake was taken on the road nearby, but similar habitat exists within the property, and the population is undoubtedly contiguous. In addition, we observed some species in 2002 at park units where we had not found them in 2001, and we also collected voucher specimens of some species we previously only observed. Review of Degenhardt et al. (1996) revealed that both the Red-spotted Toad and Roundtail Horned Lizard collected in 2001 at Abo are new Torrence County records. Most of the species likely to occur at SAPU that we did not find in 2001-2002 (i.e. those ranked as "3" in Appendix E) are snakes (e.g., Ringneck Snake, Hognose Snake, Milk Snake, Graham Patchnose Snake, Plains Black-headed Snake). The Hognose Snake has been collected just south of Gran Quivira (Degenhardt et al. 1996), so we feel confident this species occurs there. Any field efforts in 2003 will be targeted searches for these species, as well as for amphibians (e.g. Striped Chorus Frog) at Abo and Quarai.

### i. Sunset Crater Volcano National Monument (SUCR)

Between our surveys at SUCR in 2001-2002 and previously documented species (Table i1), we estimate an inventory completeness of 49% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table i1.** Amphibian and reptile species documented for SUCR. An asterisk (*) denotes a species represented by a voucher specimen.

*Eastern Fence Lizard
*Tree Lizard
*Short-horned Lizard
*Plateau Striped Whiptail
Gopher Snake

Table i2 shows the number of species and individuals detected by each method at the park in 2002.

**Table i2**. Number of individuals and species detected by different methods at SUCR in 2002. An "X" in a column indicates that the method was not used at the park.

| SUCR | 1-Ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 0 | 0 | X | 0 | X | **0** |
| Species | 0 | 0 | 0 | X | 0 | X | **0** |
| **Lizards** | | | | | | | |
| Individuals | 10 | 6 | 11 | X | 0 | X | **27** |
| Species | 2 | 3 | 2 | X | 0 | X | **4** |
| **Snakes** | | | | | | | |
| Individuals | 0 | 0 | 0 | X | 0 | X | **0** |
| Species | 0 | 0 | 0 | X | 0 | X | **0** |
| **Total** | | | | | | | |
| **Individuals** | **10** | **6** | **11** | **X** | **0** | **X** | **27** |
| **Species** | **2** | **3** | **2** | **X** | **0** | **X** | **4** |

We found no new species at SUCR in 2002, despite increased sampling, including random plot surveys, general surveys, and nighttime road surveys. We did collect a specimen of the Plateau Striped Whiptail, a species only observed in 2001, and we found this species to be more widespread in the monument, although still uncommon. We have included data from literature (e.g. Bateman 1976, 1980) and museum searches (e.g. Museum of Northern Arizona, Northern Arizona University, Arizona State University, University of Arizona) likely to yield relevant data, but the only addition to the species list is Gopher Snake, and this is based on the

observation of a road-killed specimen observed by one of us (TBP) in 1996. That we conducted road cruising surveys on warm, rainy nights during the monsoon season without success suggests that perhaps SUCR is without an amphibian fauna. This would not be wholly unsurprising, based on the cinder soil in the monument, which has extremely poor water retention qualities. We have never observed temporary pools at SUCR. A Tiger Salamander was previously observed by NPS personnel near the SUCR visitor center (*fide* Tim Graham), but this location is not within the monument, and is adjacent to Bonito Park, an area that may provide amphibian breeding habitat in wet years.

## j. Walnut Canyon National Monument (WACA)

Between our surveys at WACA in 2001-2002 and previously documented species (Table j1), we estimate an inventory completeness of 58% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table j1.** Amphibian and reptile species documented for WACA. An asterisk (*) denotes a species represented by a voucher specimen.

*Canyon Treefrog
*New Mexico Spadefoot
*Short-horned Lizard
*Eastern Fence Lizard
*Tree Lizard
*Little Striped Whiptail
*Plateau Striped Whiptail
*Ringneck Snake
*Sonoran Mountain Kingsnake
*Gopher Snake
*Western Terrestrial Garter Snake
*Western Rattlesnake

Table j2 shows the number of species and individuals detected by each method at the park in 2002.

**Table j2**. Number of individuals and species detected by different methods at WACA in 2002.

| WACA | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 0 | 14 + tadpoles | 6 | 3 | 0 | **23** |
| Species | 0 | 0 | 1 | 2 | 1 | 0 | **2** |
| **Lizards** | | | | | | | |
| Individuals | 54 | 52 | 266 | 0 | 1 | 6 | **379** |
| Species | 2 | 2 | 4 | 0 | 1 | 1 | **4** |
| **Snakes** | | | | | | | |
| Individuals | 0 | 0 | 10 | 0 | 1 | 0 | **11** |
| Species | 0 | 0 | 3 | 0 | 1 | 0 | **3** |
| **Total** | | | | | | | |
| **Individuals** | **54** | **52** | **290** | **6** | **5** | **6** | **413** |
| **Species** | **2** | **2** | **8** | **2** | **3** | **1** | **9** |

We documented one new species (New Mexico Spadefoot) at WACA in 2002, which we found along the monument entrance road, and also in the sewage lagoons near the residence area. We also found Canyon Treefrogs in the sewage lagoon, which was surprising, and represents only the second locality within the monument, the other being more typical habitat of the tinajas in upper Cherry Canyon. We conducted limited surveys (on our own time, of course) outside of WACA, to evaluate the degree of isolation of WACA Canyon Treefrog populations. We found no treefrogs, or suitable looking habitat, in canyons to the south of the monument. The species does occur at Turkey Tanks, north of Winona, which is within the same drainage as Walnut Canyon (but called San Francisco Wash in that area), and otherwise is only known from upper tributaries of Oak Creek (e.g. Pumphouse Wash near Kachina Village). The WACA population(s) appear to be somewhat isolated, although probably only recently, and a series of wet decades, or a wet century may reconnect populations again.

As discussed in Nowak et al. (2002), an exciting find at WACA in 2001 was the discovery of Little Striped Whiptail, as well as two morphological types of the Plateau Striped Whiptail complex. In 2002, we did not extend the range of either of these species within WACA, although suitable whiptail habitat appears to exist, in patches, further upstream of Walnut Canyon than near Santa Fe Dam, where lizards were found in both 2001 and 2002. The drought of 2002 greatly reduced activity of many species, especially whiptails, throughout the region (personal observation).

Our estimates of inventory completeness have substantially increased by inclusion of museum specimen data, and currently no reliably observed species are unvouchered by specimens. We have received unconfirmed reports of Many-lined Skink (Mary Blasing, personal communication) and Black-tailed Rattlesnake (Tom Ferrell, personal communication), both species we expect to occur. In addition, we expect some species associated with Mogollon Rim/central Arizona highland habitats, especially Great Plains Skink and Madrean Alligator Lizard, to also occur at WACA. Both of these lizards occur just to the south and west of Flagstaff, including in habitats present at WACA. Future efforts should be directed towards finding these more elusive species.

## k. Wupatki National Monument (WUPA)

Between our surveys at WUPA in 2001-2002 and previously documented species (Table k1), we estimate an inventory completeness of 92% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table k1.** Amphibian and reptile species documented for WUPA. An asterisk (*) denotes a species represented by a voucher specimen.

*Tiger Salamander
*Great Plains Toad
*Red-spotted Toad
Woodhouse's Toad
*Plains Spadefoot
*New Mexico Spadefoot
*Western Banded Gecko
*Common Collared Lizard
*Longnose Leopard Lizard
*Lesser Earless Lizard
*Short-horned Lizard
*Desert Spiny Lizard
*Eastern Fence Lizard
*Tree Lizard
*Side-blotched Lizard
*Little Striped Whiptail
*Plateau Striped Whiptail
*Western Whiptail
*Glossy Snake
*Night Snake
*Common Kingsnake
*Striped Whipsnake
*Gopher Snake
*Western Patchnose Snake
*Ground Snake
*Western Rattlesnake

Table k2 shows the number of species and individuals detected by each method at the park in 2002.

**Table k2**. Number of individuals and species detected by different methods at WUPA in 2002. An "X" in a column indicates that the method was not used at the park.

| WUPA | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | 0 | 0 | 0 | X | 31 | 0 | **31** |
| Species | 0 | 0 | 0 | X | 4 | 0 | **4** |
| **Lizards** | | | | | | | |
| Individuals | 11 | 43 | 391 | X | 2 | 9 | **456** |
| Species | 5 | 7 | 10 | X | 2 | 5 | **11** |
| **Snakes** | | | | | | | |
| Individuals | 0 | 1 | 4 | X | 7 | 0 | **12** |
| Species | 0 | 1 | 4 | X | 4 | 0 | **5** |
| **Total** | | | | | | | |
| **Individuals** | **11** | **44** | **395** | **X** | **40** | **9** | **499** |
| **Species** | **5** | **8** | **14** | **X** | **10** | **5** | **20** |

The most exciting find at any SCP park in 2002 was the discovery of Western Banded Gecko at WUPA. Previously, this species was only known from Sonoran and Mojave desert regions, in Arizona south of the Mogollon Rim and extending eastward along the Colorado River into Grand Canyon National Park. Brennan et al. (2002) recently reported a specimen from Lake Powell (Antelope Point) at Glen Canyon National Recreation Area, but WUPA represents the first record for the Little Colorado River basin. Together with the Lake Powell record, it establishes occurrence in Great Basin desertscrub habitats. We found three specimens at WUPA in 2002, two in Deadman Wash (one collected) and one in Kana-a Wash (collected), all under slabs of sandstone. It is likely that geckos have extended their distribution up the Little Colorado River Valley from Grand Canyon, as is the case with other more conspicuous species (Desert Spiny Lizard, Western Patchnose Snake) that reach the local terminus of their distributions near WUPA.

In addition to the gecko, we collected an adult Tiger Salamander late in 2002, on the paved road near Heiser Spring, on a rainy night. There is one older (1980's) observation of Tiger Salamander by NPS personnel, but this represents the first documented record. By documenting these two new species, and including specimens from previous studies (e.g. Persons 2001) and other museum records (Persons and Bradley 1999, NPS collections), we have increased our estimate of inventory completeness substantially. The only species with a high probability of occurrence that remain to be documented are Woodhouse's Toad, Sagebrush Lizard, and Milk Snake (Appendix E). We observed but could not catch a Woodhouse's Toad during this study, and Milk Snakes have been collected twice previously (1930's and 1950's) on US 89 near the WUPA north entrance, and undoubtedly occur in the monument. The Sagebrush Lizard has a patchy distribution in the local WUPA region, but has been collected nearby, and almost certainly occurs somewhere within the monument as one or more isolated populations.

Random plot surveys at WUPA in 2002 produced very few individuals of even fewer species. All significant finds were made during general daytime surveys or nighttime road cruising. In 2003, we will do limited targeted surveying, particularly for Woodhouse's Toad along the Little Colorado River in Spring (provided snowmelt runoff from the White Mountains, of which there was none in Spring of 2002), and for Sagebrush Lizard. Hopefully at some future point NPS personnel will happen upon a Milk Snake on the road, and collect it.

## l. Yucca House National Monument (YUHO)

Between our surveys at YUHO in 2001-2002 and previously documented species (Table l1), we estimate an inventory completeness of 75% (Appendix E). See Appendix E for details of species documentation (this study versus previous ones).

**Table l1.** Amphibian and reptile species documented for YUHO. An asterisk (*) denotes a species represented by a voucher specimen.

Tiger Salamander
*Woodhouse's Toad
Striped Chorus Frog
Short-horned Lizard
*Sagebrush Lizard
*Eastern Fence Lizard
*Side-blotched Lizard
*Plateau Striped Whiptail
Striped Whipsnake
Gopher Snake
*Western Terrestrial Garter Snake
*Western Rattlesnake

Table l2 shows the number of species and individuals detected by each method at the park in 2002.

**Table l2**. Number of individuals and species detected by different methods at YUHO in 2002. An "X" in a column indicates that the method was not used at that park.

| YUHO | 1-ha Random Plots | 10-ha Random Plots | General Surveys | Nocturnal General Surveys | Night Driving | Random Encounters | TOTAL |
|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | |
| Individuals | X | X | 1 | 15 | X | 1 | **17** |
| Species | X | X | 1 | 1 | X | 1 | **1** |
| **Lizards** | | | | | | | |
| Individuals | X | X | 40 | 0 | X | 0 | **40** |
| Species | X | X | 4 | 0 | X | 0 | **4** |
| **Snakes** | | | | | | | |
| Individuals | X | X | 31 | 0 | X | 2 | **33** |
| Species | X | X | 3 | 0 | X | 2 | **3** |
| **Total** | | | | | | | |
| **Individuals** | **X** | **X** | **72** | **15** | **X** | **3** | **90** |
| **Species** | **X** | **X** | **8** | **1** | **X** | **3** | **8** |

We observed one new species (Short-horned Lizard) at YUHO in 2002, and we collected a voucher specimen of Woodhouse's Toad. In addition, we reviewed Mesa Verde collection records, which contain only a few specimens of Western Rattlesnake from YUHO, thus relieving us of the duty to collect one. As in 2002, we included the surrounding "Ismay" lands in our surveys, but the most promising habitats continue to be the monument itself (including the unexcavated ruin rubble mounds) and immediate vicinity, especially the large, permanent pond just west of the monument proper. Additional funds will enable us to continue surveys in 2003, and we will focus extensively on surrounding land (to be acquired by NPS), but we will also continue surveys of the original monument property in hope of finding many suspected snake species, and vouchering ones (Gopher Snake, Striped Whipsnake) so far only observed.

## **Appendix D**. Scientific names of amphibians and reptiles used in the text.

**Amphibians**

Tiger Salamander *(Ambystoma tigrinum*)
Jemez Mountains Salamander (*Plethodon neomexicanus*)
Great Plains Toad (*Bufo cognatus*)
Red-spotted Toad (*Bufo punctatus*)
Woodhouse's Toad (*Bufo woodhousii)*
Canyon Treefrog (*Hyla arenicolor*)
Mountain Treefrog (*Hyla exemia*)
Striped Chorus Frog (*Pseudacris triseriata*)
Couch's Spadefoot (*Scaphiopus couchii*)
Plains Spadefoot (*Spea bombifrons*)
New Mexico Spadefoot (*Spea multiplicata*)
Bullfrog (*Rana catesbeiana*)
Northern Leopard Frog (*Rana pipiens*)

**Turtles and Tortoises**

Snapping Turtle (*Chelydra serpentina*)
Painted Turtle (*Chrysemys picta*)
Slider (*Pseudemys scripta*)
Western Box Turtle (*Terrapene ornata*)
Spiny Softshell (*Trionyx spiniferus*)

**Lizards**

Madrean Alligator Lizard (*Elgaria kingii*)
Common Collared Lizard (*Crotaphytus collaris*)
Longnose Leopard Lizard (*Gambelia wislizenii*)
Lesser Earless Lizard (*Holbrookia maculata*)
Texas Horned Lizard (*Phrynosoma cornutum*)
Short-horned Lizard (*Phrynosoma douglassii*)
Roundtail Horned Lizard (*Phrynosoma modestum*)
Sagebrush Lizard (*Sceloporus graciosus*)
Desert Spiny Lizard (*Sceloporus magister*)
Eastern Fence Lizard (*Sceloporus undulatus*)
Tree Lizard (*Urosaurus ornatus*)
Side-blotched Lizard (*Uta stansburiana*)
Many-lined Skink (*Eumeces multivirgatus*)
Great Plains Skink (*Eumeces obsoletus*)
Chihuahuan Spotted Whiptail (*Cnemidophorus exsanguis*)
Little Striped Whiptail (*Cnemidophorus inornatus*)
New Mexican Whiptail (*Cnemidophorus neomexicanus*)
Checkered Whiptail (*Cnemidophorus tesselatus*)
Western Whiptail (*Cnemidophorus tigris*)
Plateau Striped Whiptail (*Cnemidophorus velox*)
Desert Night Lizard (*Xantusia vigilis*)
Western Banded Gecko (*Coleonyx variegatus*)

Appendix D, continued.

**Snakes**

Glossy Snake (*Arizona elegans*)
Racer (*Coluber constrictor*)
Ringneck Snake (*Diadophis punctatus*)
Corn Snake (*Elaphe guttata*)
Chihuhuan Hook-nosed Snake (*Gyalopion canum*)
Western Hognose Snake (*Heterodon nasicus*)
Night Snake (*Hypsiglena torquata*)
Common Kingsnake (*Lampropeltis getulus*)
Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*)
Milk Snake (*Lampropeltis triangulum*)
Smooth Green Snake (*Liochlorophis vernalis*)
Coachwhip (*Masticophis flagellum*)
Striped Whipsnake (*Masticophis taeniatus*)
Gopher Snake (*Pituphis catenifer*)
Long-nosed Snake (*Rhinocheilus lecontei*)
Graham Patchnose Snake (*Salvadora grahamii*)
Western Patchnose Snake (*Salvadora hexalepis*)
Ground Snake (*Sonora semiannulata*)
Southwestern Black-headed Snake (*Tantilla hobartsmithi*)
Plains Black-headed Snake (*Tantilla nigriceps*)
Black-necked Garter Snake (*Thamnophis cyrtopsis*)
Western Terrestrial Garter Snake (*Thamnophis elegans*)
Checkered Garter Snake (*Thamnophis marcianus*)
Common Garter Snake (*Thamnophis sirtalis*)
Lyre Snake (*Trimorphodon biscutatus*)
Lined Snake (*Tropidoclonion lineatum*)
Western Diamondback Rattlesnake (*Crotalus atrox*)
Black-tailed Rattlesnake (*Crotalus molossus*)
Western Rattlesnake (*Crotalus viridis*)
Massasauga (*Sistrurus catenatus*)
Texas Blind Snake (*Leptotyphlops dulcis*)

**Appendix E.** All amphibian and reptile species found or expected to occur in the twelve SCP park areas surveyed in 2001-2002. Ranking of probability of species occurrences is as follows: 1 = low probability, 2 = medium probability, and 3 = high probability. SX = specimen collected, this study. SP = specimen collected, previous study. OX = species observed, this study. OP = species observed previously (only included if observation(s) reliable). Although a species in a given park may be represented by multiple categories, only the "hardest" evidence is given, i.e. a specimen trumps an observation, and data from this study trumps previous data. Weighted total is equivalent to the total number of species expected to occur in each park, and estimated inventory completeness is simply the number documented (SX, SP, OX, or OP) divided by the weighted total.

| SPECIES | AZRU | BAND | CHCU | ELMA | ELMO | HOVE | PETR | SAPU | SUCR | WACA | WUPA | YUHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Amphibians** | | | | | | | | | | | | |
| Tiger Salamander | 3 | SX | SP | OP | SP | SX | 3 | SX | 2 | 3 | SX | OX |
| Jemez Mtns. Salamander | | SP | | | | | | | | | | |
| Great Plains Toad | | | 1 | | | | 3 | 1 | | | SP | |
| Red-spotted Toad | 1 | OP | 2 | 1 | 1 | SX | 3 | SX | | 2 | SP | 1 |
| Woodhouse's Toad | SX | OX | 3 | 1 | 1 | OX | 3 | OX | | 1 | OX | SX |
| Canyon Treefrog | | SP | | OP | | 1 | | | | SX | | |
| Mountain Treefrog | | | | | | | | | | 1 | | |
| Striped Chorus Frog | SX | OP | | | 1 | | | 1 | | 2 | | OX |
| Couch's Spadefoot | | | | | | | 3 | | | | | |
| Plains Spadefoot | 3 | 1 | SP | SX | SP | 3 | 3 | SX | | | SX | |
| New Mexico Spadefoot | 3 | 3 | SP | SX | SP | SX | OX | SX | 1 | SX | SX | 2 |
| Bullfrog | | OX | | | | | | 1 | | | | 1 |
| Northern Leopard Frog | | | | | | | | 1 | | | | 1 |
| **Turtles and Tortoises** | | | | | | | | | | | | |
| Snapping Turtle | | | | | | | 1 | | | | | |
| Painted Turtle | 1 | 1 | | | | | 1 | | | | | |
| Slider | | | | | | | 1 | | | | | |
| Western Box Turtle | | | | | | | 3 | 1 | | | | |
| Spiny Softshell | | 2 | | | | | 1 | | | | | |

**Appendix E**, **continued.**

| SPECIES | AZRU | BAND | CHCU | ELMA | ELMO | HOVE | PETR | SAPU | SUCR | WACA | WUPA | YUHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lizards** | | | | | | | | | | | | |
| Madrean Alligator Lizard | | | | | | | | | | 2 | | |
| Western Banded Gecko | | | | | | | | | | | SX | |
| Common Collared Lizard | SX | SP | SP | OP | 1 | SX | OX | SX | | 1 | SP | 1 |
| Longnose Leopard Lizard | 1 | | 2 | | | SX | OX | 1 | | | SX | |
| Lesser Earless Lizard | 2 | 1 | SP | OP | 1 | 1 | OX | OX | | 1 | SX | |
| Texas Horned Lizard | | | | | | | | 1 | | | | |
| Short-horned Lizard | 3 | SP | SP | OP | OX | 3 | OX | 3 | SX | SP | SP | OX |
| Roundtail Horned Lizard | | 1 | | | | | SX | SX | | | | |
| Sagebrush Lizard | SX | | SP | 1 | | SX | | | | 1 | 3 | SX |
| Desert Spiny Lizard | | | | | | SX | | | | | SX | |
| Eastern Fence Lizard | SX | OX | SP | OX | SP | SX | SX | SX | SX | SP | SX | SX |
| Tree Lizard | 1 | OX | SP | OX | SP | SX | 1 | SX | SX | SP | SX | 1 |
| Side-blotched Lizard | 1 | | SP | | | SX | SX | | | | SX | SX |
| Many-lined Skink | 2 | SX | 3 | OP | OX | 3 | 2 | 3 | 3 | 3 | 1 | 3 |
| Great Plains Skink | | OX | | OP | 1 | | SX | SX | | 2 | | |
| Chihuahuan Spotted Whiptail | | SX | | *OP? | | | 3 | SX | | | | |
| Little Striped Whiptail | 1 | | 2 | | | | SX | SX | | SX | SX | |
| New Mexican Whiptail | | 3 | | | | | OX | | | | | |
| Checkered Whiptail | | SP | | | | | 1 | 1 | | | | |
| Western Whiptail | SX | | 1 | | | SX | 1 | | | | SX | |
| Plateau Striped Whiptail | SX | SX | SX | SX | OX | 2 | | 1 | SX | SX | SX | SX |
| Desert Night Lizard | | | | | | 1 | | | | | | |

* Questionable record, not included in analyses

**Appendix E, continued.**

| SPECIES | AZRU | BAND | CHCU | ELMA | ELMO | HOVE | PETR | SAPU | SUCR | WACA | WUPA | YUHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Snakes** | | | | | | | | | | | | |
| Glossy Snake | 3 | 2 | | | | 3 | 3 | SX | | 1 | SP | |
| Racer | 1 | | | | | | 3 | | | | | |
| Ringneck Snake | 1 | SP | 1 | 3 | 1 | 1 | SX | 3 | | SP | | 1 |
| Corn Snake | | 3 | | 2 | 1 | | 3 | | | | | |
| Chihuhuan Hook-nosed Snake | | | | | | | 3 | | | | | |
| Western Hognose Snake | 2 | 1 | 2 | 1 | 1 | | 3 | 3 | | | | |
| Night Snake | 3 | 3 | SX | 3 | SX | 3 | 3 | 3 | 3 | 3 | SX | 3 |
| Common Kingsnake | 2 | 3 | 1 | | | OP | 3 | | | | SP | |
| Sonoran Mountain Kingsnake | | | | | | | | | 3 | SP | | |
| Milk Snake | 2 | 1 | 1 | 2 | OP | 3 | 1 | 3 | | 1 | 3 | 2 |
| Smooth Green Snake | | 2 | | | | 2 | | | | | | 1 |
| Coachwhip | | 2 | | | | | OX | | | | | |
| Striped Whipsnake | OX | OP | SP | OP | 3 | OX | SX | OX | 3 | 3 | SP | OX |
| Gopher Snake | OX | SP | SP | OP | SP | SX | 3 | SP | OP | SP | SP | OX |
| Long-nosed Snake | | 2 | | | | | OX | 1 | | | | |
| Graham Patchnose Snake | | OX | | 3 | 1 | | 1 | 3 | | | | |
| Western Patchnose Snake | | | | | | | | | | 3 | SP | |
| Ground Snake | | | | | | | | | | | SP | |
| Southwestern Black-headed Snake | 1 | | | | | 1 | | | | 1 | 1 | |
| Plains Black-headed Snake | | | | | | | 3 | 3 | | | | |
| Black-necked Garter Snake | 1 | 3 | 1 | 1 | 1 | 1 | 1 | SX | | 1 | 1 | 1 |
| Western Terrestrial Garter Snake | SX | OX | SX | OP | SP | 1 | 1 | SX | 1 | SX | 1 | SX |
| Checkered Garter Snake | | | | | | | 1 | | | | | |
| Common Garter Snake | | | | | | | 3 | | | | | |
| Lyre Snake | | | | | | | | | | 1 | | |
| Lined Snake | | | | | | | | SX | | | | |
| Western Diamondback Rattlesnake | | OX | | OP | | | OX | OX | | | | |
| Black-tailed Rattlesnake | | | | | | | 2 | 2 | 1 | 3 | | |
| Western Rattlesnake | OX | 3 | SP | OP | SP | OX | OX | OX | 3 | SP | SP | SP |
| Massasauga | | | | | | | 3 | 2 | | | | |
| Texas Blind Snake | | 3 | | | | | SX | 1 | | | | |
| **TOTAL RANK 1** | **10** | **6** | **6** | **5** | **11** | **7** | **11** | **11** | **3** | **10** | **4** | **7** |
| **TOTAL RANK 2** | **5** | **5** | **4** | **2** | **0** | **2** | **2** | **1** | **1** | **4** | **0** | **2** |
| **TOTAL RANK 3** | **6** | **8** | **2** | **3** | **1** | **6** | **19** | **8** | **5** | **6** | **2** | **2** |
| **TOTAL FOUND (X)** | **11** | **22** | **16** | **17** | **13** | **16** | **18** | **21** | **5** | **12** | **26** | **12** |
| **WEIGHTED TOTAL** | **20.2** | **32.2** | **20.7** | **21.3** | **15.7** | **23.2** | **36.6** | **30.0** | **10.2** | **20.7** | **28.3** | **15.9** |
| **ESTIMATED INVENTORY COMPLETENESS** | **54%** | **68%** | **77%** | **80%** | **83%** | **69%** | **49%** | **70%** | **49%** | **58%** | **92%** | **75%** |

**Appendix F**. Amphibians and reptiles collected at 12 southern Colorado Plateau National Park areas (including Hovenweep National Monument) in 2002. Collector abbreviations are AJM = A.J. Monatesti, EMN = Erika M. Nowak, EZ = Eric Zepnewski, TBP = Trevor B. Persons, RE = R. Emerson, RJP = Renata J. Platenberg, and SCK = Shawn C. Knox. For convenience, all specimens, regardless of collector, were assigned numbers in the field catalog of Trevor B. Persons.

| Species | Park | Field Number | Date | Collector(s) | UTM East | UTM North | Locality | notes |
|---|---|---|---|---|---|---|---|---|
| Tiger Salamander | BAND | TBP 179 | 5/29/2002 | TBP | 371166 | 3967927 | Stock tank just southwest of jct. of Dome Road with SR 4 | Regular terrestrial form |
| Tiger Salamander | BAND | TBP 180 | 5/29/2002 | TBP | 371166 | 3967927 | Stock tank just southwest of jct. of Dome Road with SR 4 | Regular terrestrial form |
| Tiger Salamander | WUPA | TBP 258 | 9/7/2002 | TBP | 468239 | 3929185 | FR 545, 0.2 miles north of south turnoff to Heiser Spring area | Regular terrestrial form |
| Red-spotted Toad | HOVE | TBP 231 | 8/6/2002 | TBP | 670440 | 4139215 | Visitor center patio | |
| Woodhouse's Toad | YUHO | TBP 183 | 5/30/2002 | EMN | 705497 | 4126197 | Pond on Ismay land ca. 3/4 mile NNE of monument (ruins), e-cen. Sec. 26, T35N R17W | 1 of 6 in breeding chorus. SVL 76 mm, 63.5 g. |
| Canyon Treefrog | WACA | TBP 201 | 7/12/2002 | TBP | | | Sewage Lagoons (northwestmost of 3 ponds), SE/4 of NE/4 of Sec. 26, T21N R8E | |
| Plains Spadefoot | ELMA | TBP 247 | 8/8/2002 | AJM | 774767 | 3844709 | SR 117, 1.7 rd. miles north of jct. with CR 42 | |
| Plains Spadefoot | ELMA | TBP 248 | 8/8/2002 | AJM | 772663 | 3844045 | SR 117, 0.3 rd. miles north of jct. with CR 42 | |
| Plains Spadefoot | WUPA | TBP 198 | 7/10/2002 | TBP | 466851 | 3930254 | FR 545 at jct. of Wukoki Ruins road. | |
| New Mexico Spadefoot | ELMA | TBP 221 | 7/22/2002 | AJM | | | SR 117, 10.3 rd. miles s. of South Narrows campground | |
| New Mexico Spadefoot | ELMA | TBP 222 | 7/22/2002 | AJM | | | SR 117, 9.0 rd. miles s. of South Narrows campground. | |
| New Mexico Spadefoot | ELMA | TBP 223 | 7/22/2002 | AJM | | | SR 117, 3.8 rd. miles s. South Narrows campground | |
| New Mexico Spadefoot | ELMA | TBP 224 | 7/22/2002 | AJM | | | SR 117, 6.8 miles s. of South Narrows campground | |
| New Mexico Spadefoot | HOVE | TBP 230 | 8/6/2002 | TBP | 670259 | 4139547 | Entrance road to Square Tower unit, ca. 10 m. s. of n. boundary. | |
| New Mexico Spadefoot | WACA | TBP 200 | 7/12/2002 | TBP | 454171 | 3892497 | Just s. of FR 303 on entrance road | |
| New Mexico Spadefoot | WUPA | TBP 197 | 7/10/2002 | TBP | 457213 | 3936320 | FR 545, ca. 200 m. w. of Lomaki rd. | |
| Common Collared Lizard | HOVE | TBP 232 | 8/7/2002 | TBP | 670967 | 4138801 | Canyon east of campground, Square Tower unit | |
| Many-lined Skink | BAND | TBP 178 | 5/29/2002 | TBP | 384985 | 3960171 | Along Frijoles Creek in monument headquarters area | |
| Great Plains Skink | SAPU | TBP 170 | 4/25/2002 | SCK | 381345 | 3828907 | Quarai unit. | |
| Tree Lizard | SAPU | TBP 193 | 7/2/2002 | TBP | 373260 | 3812612 | Rocky side wash of Canyon Espinoso, SW corner of Abo unit | |
| Side-blotched Lizard | WUPA | TBP 172 | 5/8/2002 | TBP | 466806 | 3934463 | West of Doney Mountain Wash | Squashed under rock. |
| Chihuahuan Spotted Whiptail | BAND | TBP 204 | 7/7/2002 | AJM | 383096 | 3952860 | Mouth of Alamo Canyon (confluence with Rio Grande) | |
| Little Striped Whiptail | SAPU | TBP 253 | 8/6/2002 | EZ | 398160 | 3790873 | Gran Quivira unit, ca. 30 feet north of south boundary. | |
| Plateau Striped Whiptail | AZRU | TBP 214 | 7/21/2002 | EZ | | | Along Animas River | |
| Plateau Striped Whiptail | AZRU | TBP 226 | 8/6/2002 | TBP | 767223 | 4081187 | By wash above Farmer's Ditch | |
| Plateau Striped Whiptail | AZRU | TBP 227 | 8/6/2002 | TBP | 767202 | 4081070 | Near wash above Farmer's Ditch | |
| Plateau Striped Whiptail | BAND | TBP 177 | 5/28/2002 | TBP | 386081 | 3958395 | Along Falls Trail, Frijoles Canyon. | |

**Appendix F, continued.**

| Species | Park | Field Number | Date | Collector(s) | UTM East | UTM North | Locality | notes |
|---|---|---|---|---|---|---|---|---|
| Plateau Striped Whiptail | CHCU | TBP 251 | 8/7/2002 | RE, EMN | 233260 | 3994615 | Trail to Wetherill Cemetary, Pueblo Bonito Ruins | |
| Plateau Striped Whiptail | ELMA | TBP 181 | 5/31/2002 | TBP | 242201 | 3889640 | Behind Northwest New Mexico Visitor's Center, just s. of exit 85 of I-40, Grants | |
| Plateau Striped Whiptail | ELMA | TBP 182 | 6/1/2002 | TBP | 772552 | 3873443 | Ca. half mile west of El Calderon parking area off SR 53 | During random plot |
| Plateau Striped Whiptail | ELMA | TBP 225 | 7/23/2002 | AJM | 228889 | 3849950 | Just west of SR 117 about 4 miles north of CR 44 | |
| Plateau Striped Whiptail | ELMA | TBP 249 | 8/8/2002 | AJM | 242388 | 3889604 | Ca. 0.05 mi. SE of parking lot at NW New Mexico Visitor's Center, just s. exit 85 of I-40, Grants | |
| Plateau Striped Whiptail | ELMA | TBP 250 | 8/8/2002 | AJM | 242508 | 3889145 | Ca. 0.34 mi. SE of parking area at NW New Mexico Visitor's Center, just s. exit 85 of I-40, Grants | |
| Plateau Striped Whiptail | SUCR | TBP 175 | 5/17/2002 | TBP | 455383 | 3914949 | Near northeast corner of monument, ca. 6940 feet elev. | |
| Plateau Striped Whiptail | WUPA | TBP 168 | 4/23/2002 | TBP | 467761 | 3931562 | Deadman Wash, ca. half mile east of FR 545, ca. 4660 feet elev. | |
| Plateau Striped Whiptail | YUHO | TBP 233 | 8/8/2002 | TBP | 704972 | 4125070 | Ismay property, by Ute Mtn. ditch, w. of original mon. (ruins). | |
| Plateau Striped Whiptail | YUHO | TBP 234 | 8/9/2002 | TBP | 705129 | 4124983 | Pond just west of original monument (ruins). | |
| Plateau Striped Whiptail | YUHO | TBP 235 | 8/9/2002 | TBP | 705153 | 4124958 | By pond just west of original monument (ruins). | |
| Plateau Striped Whiptail | YUHO | TBP 262 | 8/23/2002 | RJP | 705130 | 4124635 | Gravel pit area of Ismay land just s. of original monument (ruins). | |
| Western Banded Gecko | WUPA | TBP 167 | 4/23/2002 | TBP | 468940 | 3932197 | Deadman Wash, SE/4 of NE/4 of NE/4 of Sec. 20, T25N R10E, ca. 4560 feet elev. | Under sandstone slab, SVL 43 mm, VT 44 |
| Western Banded Gecko | WUPA | TBP 259 | 9/10/2002 | TBP | 470658 | 3931404 | Kana-a Wash, ca. 1/4 mile SE of Wukoki Ruin, ca. 4600 feet elev. | Under sandstone slab |
| Night Snake | CHCU | TBP 220 | 7/18/2002 | AJM | 238748 | 3991020 | Main visitor's road, 2.0 rd. mi. from park entrance on CR 7900 | |
| Night Snake | ELMO | TBP 255 | 8/9/2002 | EZ | | | Campground | |
| Night Snake | SAPU | TBP 191 | 7/1/2002 | TBP | 400275 | 3791702 | SR 55, 1.2 rd. mi. e. of entrance to Gran Quivira ruins | |
| Night Snake | SAPU | TBP 194 | 7/2/2002 | TBP | 373553 | 3812331 | Paved road just s. of Canyon Espinoso, Abo unit. | |
| Night Snake | WUPA | TBP 213 | 7/24/2002 | TBP | | | FR 545, mp 11.0, center of Sec. 13, T25N R9E, elev. ca. 4890 feet. | DOR |
| Texas Blind Snake | PETR | TBP 195 | 6/20/2002 | RA, SC | 342442 | 3887702 | Along south edge of Rinconada Canyon | Collectors Rich Anderson and Susan Caffery |
| Western Terrestrial Garter Snake | CHCU | TBP 252 | 8/7/2002 | RE, EMN | 237695 | 3991072 | Loop road just past north gate | DOR |
| Lined Snake | SAPU | TBP 254 | 8/7/2002 | EZ | | | SR 55, 0.8 rd. miles SE of entrance rd. to Quarai unit or ca. 1 air mile due east of Quarai unit | |