TRW Environmental
Safety Systems Inc.

Species Composition and Abundance of Reptile Populations in Selected Habitats at Yucca Mountain, Nevada, with Annotated Checklist

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Management & Operating Contractor

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EXECUTIVE SUMMARY

To determine the reptile species present at Yucca Mountain, Nevada, and their relative abundances, lizards and snakes were captured from 1991 to 1995 using a variety of sampling techniques. Reptiles were sampled throughout the Yucca Mountain area, but most sampling was conducted within the three major low-elevation habitat types near the Exploratory Studies Facility North Portal.

A total of 3,405 reptiles were captured, providing data on the presence, habitat preference, and habitat-specific population densities of 27 species of reptiles (12 lizard, 14 snake, and 1 tortoise species). Side-blotched lizards and western whiptail lizards were the most abundant lizards, and coachwhip snakes and long-nosed snakes were the most abundant snakes.

Only side-blotched lizards and desert tortoises were captured in all habitat types. Of the 27 species detected, 20 were captured in Creosotebush-Wolfberry-Hopsage habitat near the Exploratory Studies Facility, 16 were captured in the sandy Creosotebush-Bursage habitats in Jackass Flats, and 15 were captured in the lower-elevation Blackbrush habitat east of the Exploratory Studies Facility.

The chuckwalla, formerly a Federally-listed Category II species, was locally common and widely distributed throughout the area in rocky habitats. The desert tortoise, also widely distributed throughout the area, was the only reptile detected in the Yucca Mountain area that was Federally-listed as threatened or endangered. Demographic and natural history notes for all species found at Yucca Mountain are discussed in Appendix C.

CONTENTS

Page

1. INTRODUCTION 1

1.1 ABSTRACT 1
1.2 INTRODUCTION 1

2. METHODS 3

2.1 STUDY SITE 3
2.2 SAMPLING: GENERAL 4
2.3 SAMPLING: PITFALL AND FUNNEL TRAPPING 7
2.4 SAMPLING: NOOSING 7
2.5 SAMPLING: BELT TRANSECTS 14
2.6 SAMPLING: OPPORTUNISTIC 14
2.7 SAMPLING: ANECDOTAL OBSERVATION 15
2.8 STATISTICAL METHODS 15

3. RESULTS 17

3.1 GENERAL 17
3.2 TRAPPING (PITFALL AND FUNNEL) 17
3.3 NOOSING 20
3.4 BELT TRANSECTS 20
3.5 OPPORTUNISTIC AND ANECDOTAL OBSERVATIONS 22
3.6 SUMMARY 24

4. DISCUSSION 28

5. REFERENCES 32

APPENDIX A — PLOT LOCATION AND SAMPLING METHODS. A-1

APPENDIX B — SCHEDULE OF REPTILE SAMPLING ON 25 PLOTS B-1

APPENDIX C — ANNOTATED CHECKLIST OF REPTILES C-1

APPENDIX D — NUMBER CAPTURED USING TRAPPING TECHNIQUES D-1

APPENDIX E — NUMBER CAPTURED USING NOOSING TECHNIQUES E-1

APPENDIX F — REPTILE SPECIMEN COLLECTION CATALOG F-1

FIGURES

Page

1. Location of Yucca Mountain in relation to the Mojave and Great Basin deserts. 4
2. Location of the 48 original study plots. 5
3. Location of the three reptile trapping plots. 8
4. Layout of pitfall traps, funnel traps, and drift fences used on trapping plots. 9
5. Location of noosing plots 11
6. Location of noosing plots on the northern flank of Little Skull Mountain. 13
7. Location of chuckwalla observation records. 23
8. Number of times individual reptiles were captured. 25
9. Cumulative number of species observed versus sampling effort 27

TABLES

		Page
1.	Generalized schedule of trapping and noosing.	10
2.	Relative abundances of reptile species based on four sampling methods.	18
3.	Average naive densities (number per ha) of reptiles in four habitat types.	19
4.	Densities of reptiles in three habitat types using visual observations.	21
5.	Susceptibility of reptiles to three sampling methods.	26

1. INTRODUCTION

1.1 ABSTRACT

From 1991 to 1995, density and species composition of reptile populations in the transition zone between the Great Basin and Mojave deserts were examined using mark-release-recapture and a variety of other sampling techniques in four habitat types. These efforts documented the presence of 27 reptilian species (12 lizards, 14 snakes, 1 tortoise) in the vicinity of Yucca Mountain. The most abundant lizards were side-blotched lizards (*Uta stansburiana*) and western whiptail lizards (*Cnemidophorus tigris*), with average densities of approximately 14 to 55 ha^{-1} and 3 to 25 ha^{-1}, respectively. The most abundant snakes were coachwhip snakes (*Masticophis flagellum*) and longnose snakes (*Rhinocheilus lecontei*), with average densities of approximately 0.2 to 1.0 ha^{-1} and 0.1 to 1.3 ha^{-1}, respectively. The three most intensely studied habitat types appeared to contain different species assemblages. The Creosotebush-Wolfberry-Hopsage habitat type appeared to have the highest species richness (20 species), followed by the Creosotebush-Bursage (16), and Blackbrush (15) habitat types. Capture success differed among techniques. Most species were more frequently captured using one method or another rather than being captured equally frequently with different methods, and some species were only captured using one method. Recapture rates for most species were low. The highest rate of recapture was for side-blotched lizards, and 52% of these animals were recaptured at least twice. Some snake species were never recaptured. The chuckwalla (*Sauromalus obesus*), formerly a Federally-listed Category II species, was locally common and widely distributed throughout the area in rocky habitats. The desert tortoise (*Gopherus agassizii*), also widely distributed throughout the area, was the only species detected at Yucca Mountain that was Federally listed as threatened or endangered. Demographic and natural history notes are discussed.

1.2 INTRODUCTION

Nevada has a rich history of reptile sampling (Tanner and Jorgensen 1963, and references therein), and the species composition and habitat preferences of reptiles in the Mojave and Great Basin Deserts of Nevada have been studied for years. However, little is known about these species in the transition zone between the two deserts. The first significant biotic study in the region was probably that of the Death Valley Expedition in 1891 (Stejneger 1893), although, as reviewed by Tanner and Jorgensen (1963), earlier expeditions traversed Nevada. The first checklist of Nevada reptiles was provided by Van Denburgh and Slevin (1921), and in 1940, Linsdale (1940) provided a more detailed account of Nevada reptiles, summarizing much of the collecting that preceded her efforts. More recent authors have specifically considered species composition and habitat associations of reptiles at the Nevada Test Site (Tanner and Jorgensen 1963; Tanner 1969, 1982; Medica et al. 1990). In addition, studies of reptile populations on the Nevada Test Site have contributed significantly to our understanding of reptilian reproduction (Hoddenbach and Turner 1968; Medica and Turner 1976), demography (Turner et al. 1969a, 1970, 1982), other natural history characteristics (Tanner and Krogh 1974a, 1974b), and the biotic effects of nuclear radiation (Turner et al. 1969b; Medica et al. 1973; Turner and Medica 1977; Pearson et al. 1978; Nagy and Medica 1985).

Despite the considerable research effort expended on reptiles at the Nevada Test Site, no studies have been published in the scientific literature concerning species composition, habitat associations, or densities of reptiles in the transition zone between the Mojave and Great Basin deserts. The only existing data on reptiles at Yucca Mountain were provided by a cursory survey in 1982 (O'Farrell and Collins 1983). The objectives of this report were to document the presence of non-tortoise reptilian species at Yucca Mountain and provide estimates of their abundance and distribution.

2. METHODS

2.1 STUDY SITE

Yucca Mountain lies in a transition zone between the Mojave and Great Basin Deserts in a region with rugged mountain ranges and broad valleys (Figure 1). The Yucca Mountain study area was located on the southwestern edge of the Nevada Test Site, approximately 26 km north of the town of Amargosa Valley (formerly Lathrop Wells), Nye County, Nevada. Study plots were located on the southern ridges and southeastern flanks of Yucca Mountain, a long, north-south ridge of volcanic origin, and on the northern flanks of the adjacent Little Skull Mountain, also of volcanic origin, but orientated east-west. The study area ranged in elevation from approximately 950 to 1,500 m. Vegetation was dominated by Mojave desert communities below approximately 1,200 m and by transitional communities composed of Mojave and Great Basin Desert floras at higher elevations (Beatley 1976; CRWMS M&O 1996a).

Four plant associations, as described by Beatley (1976) and detailed by CRWMS M&O (1996a), occurred within the study area.

At the lowest elevations, below approximately 1,035 m, the Creosotebush-Bursage association occurred on generally flat, sandy alluvial soils. Creosotebush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*) were the dominant perennial shrubs.

At middle elevations, between approximately 1,035 and 1,310 m, the Creosotebush-Wolfberry-Hopsage association occurred on low to moderate rocky-slopes in the upper portions of bajadas. Creosotebush was the dominant species. Nevada jointfir (*Ephedra nevadensis*), white bursage, and littleleaf ratany (*Krameria erecta*) were subdominants in this association, and Anderson's Wolfberry (*Lycium andersonii*) and spiny hopsage (*Grayia spinosa*) were uncommon. This vegetation association was also characterized by an abundance of winter annuals such as foxtail brome (*Bromus rubens*) and common fiddleneck (*Amsinckia tessellata*).

At middle and upper elevations, above approximately 1,100 m, the Blackbrush (*Coleogyne*) association occurred on the upper portions of bajadas where slopes were moderate and rocks were few, and it occurred in higher areas on flat ridge tops. At the middle elevations, this association was intermediate between Creosotebush-Bursage and Creosotebush-Wolfberry-Hopsage, and blackbrush shared dominance with Nevada jointfir and white bursage. At the higher elevations, this association was dominated by blackbrush (*Coleogyne ramosissima*) interspersed with several species of rabbitbrush (*Chrysothamnus* spp.) and jointfir (*Ephedra* spp.).

Also at higher elevations within the study area, above approximately 1,310 m, the Wolfberry-Hopsage association occurred on ridge tops and on the higher, steeper, and rockier slopes. Anderson's Wolfberry, Spiny Hopsage, Nevada jointfir, California buckwheat (*Eriogonum fasciculatum*), and a variety of shrubs from higher and lower elevations shared dominance in this association.

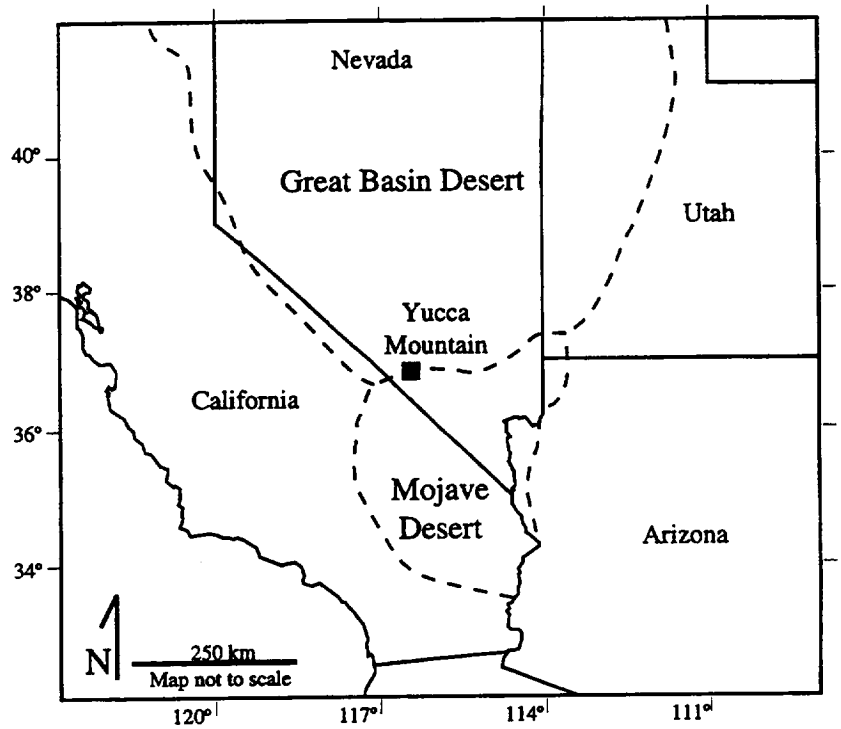

Figure 1. Yucca Mountain, Nye County, Nevada in relation to the Mojave and Great Basin deserts.

Overall, perennial shrubs covered approximately 16% of the soil surface in the Creosotebush-Bursage association, and 21 to 22% in the other associations (CRWMS M&O 1996a). Although these vegetation associations appeared relatively homogeneous at the landscape scale and may be described in simple terms, each was actually a mosaic of sub-associations consisting of the dominant shrubs, as well as less dominant shrubs, forbs, and grasses as described in detail by Beatley (1976), O'Farrell and Collins (1984), and CRWMS M&O (1996a). This smaller-scale variation within vegetation associations was often related to microtopographic features such as washes, hillsides, or rock outcrops, or to differences in soil characteristics (e.g., soil depth or presence of desert pavement).

2.2 SAMPLING: GENERAL

Sampling was primarily conducted on plots that were part of the Site Characterization Effects Program that has been described in detail by EG&G (1991, 1992, 1993, 1994, 1995) and Green et al. (1991). Briefly, 48 4-ha sampling units (200 m square) were equally allocated among four vegetation associations (Figure 2). Twelve plots within each habitat association were coded according to identification number, vegetation association, and distance from various disturbances (e.g., roads and construction activities). Vegetation associations were coded as follows: LLG = Creosotebush-Wolfberry-Hopsage (*Larrea-Lycium-Grayia*); LA = Creosotebush-Bursage (*Larrea-Ambrosia*); COL = Blackbrush (*Coleogyne*); and LG = Wolfberry-Hopsage (*Lycium-Grayia*).

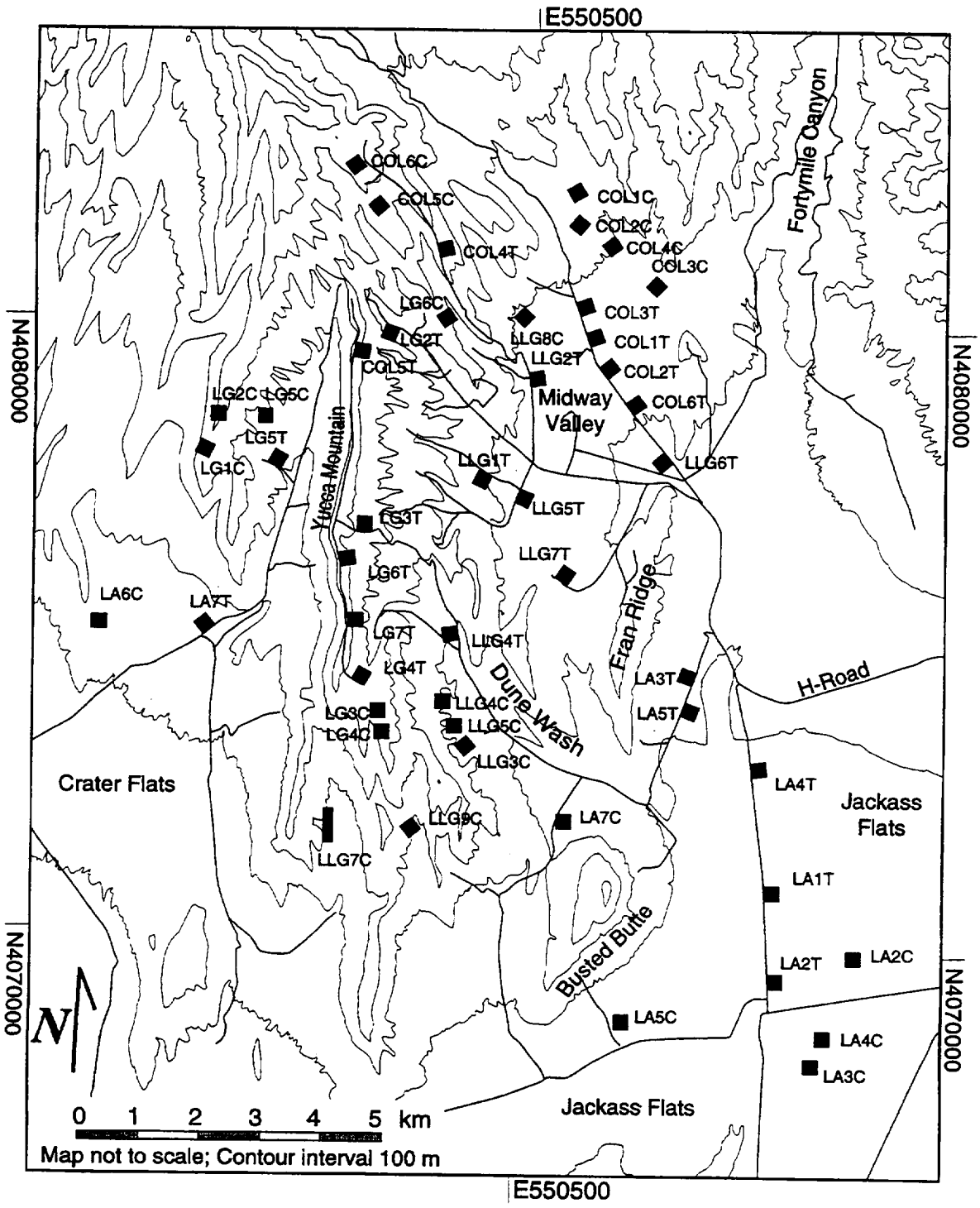

Figure 2. Location of the 48 original Site Characterization Effects Program study plots at Yucca Mountain, Nevada.

Within each vegetation association, six plots adjacent to disturbances were considered treatments (T) and six plots located more than 200 m (generally more than 500 m) from such disturbances were considered controls (C).

Reptiles were sampled on 15 of these 48 plots and on 10 additional plots that were established separately and only sampled for reptiles (Appendix A). On each of the 25 plots, a square 1-ha area was defined and marked with stakes using a 20- by 20-m grid with coordinates marked on each stake.

Lizards captured on the study plots were permanently and uniquely marked by toe-clipping with marks unique to plots. Lizards were also temporarily marked using paint because paint-marks allowed individuals to be re-sighted during daily trap sessions, thus reducing stress on the animal and eliminating time spent recapturing animals previously captured that day. In 1991 and 1992, identification numbers were painted on each animal's dorsum using Testors Corporation yellow enamel model paint and Revlon yellow enamel nail polish, respectively. In 1993 and later years, animals were marked with a spot of color (orange, silver, green, red, brown, or purple), unique for each day of a sampling session, using Faber Castell UniPaint Marker PX-10 paint-pens. A lizard could have four colored spots by the end of a sampling session. Most snakes captured on the study plots were uniquely marked by clipping ventral scales following the methods of Brown and Parker (1976). Due to the infrequency of recapture, snakes were not marked with paint.

Using the 20-m grid as a reference, the location where noosed animals were first seen, or the location where animals were trapped, was recorded each time an animal was captured. Snout-vent length, tail length, weight, sex, and presence of ova (via palpation) were recorded the first time an animal was captured during a sampling session. Animals were released near the point of capture.

Biological and physical data were recorded in each vegetation association as described by EG&G (1991, 1992, 1993, 1994, 1995). Plant community parameters (e.g., species composition, density, percent cover) were used to delineate habitat associations and select study plots, and these parameters were measured yearly in each vegetation association (CRWMS M&O 1996a). Weather parameters (e.g., cumulative rainfall, temperature, soil moisture) were recorded weekly on the 48 study plots during the growing season, and once monthly thereafter (DOE, unpublished data).

Decisions about sampling methods and sample sites were based on the global objectives of the non-tortoise reptile studies. A variety of sampling methods were tested in 1991 and 1992. From 1993 to 1995, a single sampling method was used for the primary analysis, but earlier methods were continued to provide longer-term monitoring and to sample other portions of the reptile fauna. Because the global objective of this study was to assess impacts, fixed, *a priori* decisions about sample plot locations could not be made because the anticipated sites of potential impacts changed. In some cases, DOE activities moved away from anticipated treatment plots (converting the site to a control plot), and other times they moved onto anticipated treatment plots (destroying the treatment plot). Therefore, to pursue the global objectives of this study, some sampling sites were moved in response to changing DOE activities.

2.3 SAMPLING: PITFALL AND FUNNEL TRAPPING

Pitfall and funnel trapping were conducted to document the presence of reptilian species that were secretive, rare, or rarely active on the surface during daylight hours (when they would be observed using other detection methods), and to estimate abundance of the more common reptilian species. Trapping was conducted from 1991 to 1995 on 1-ha portions of plots LA3T, COL2T, and LLG2T (Figure 3 and Appendix A). Trapping was not conducted in the high elevation LG habitat. Each trapping plot contained an array of 16 drift fences aligned in four rows with fences in each row perpendicular to one another (Figure 4). Drift fences consisted of galvanized metal flashing approximately 15 m long and 0.5 m high, buried 20 cm in the ground. The end of each drift-fence overhung a 30-cm-wide by 50-cm-deep pitfall trap (5-U.S.-gal. plastic bucket) that was buried flush with the soil surface. Traps were shaded with a plywood board (35 cm by 55 cm) raised approximately 5 cm above the pitfall trap. Two funnel traps were placed on the ground at the middle of each drift-fence, one on each side of the flashing. Funnel traps were constructed using a 20- by 20- by 56-cm frame (wooden, and later metal) covered with hardware-cloth (3 mm mesh). Cones made from the same size mesh hardware-cloth were inserted into each end of the trap.

Trapping on these plots was conducted one to three times per year for a total of seven to nine sampling sessions per plot (Table 1 and Appendix B). During each trapping session, traps were generally opened on Monday and closed on Friday. The only significant exceptions to this pattern were in 1991. In June, traps on LA3T and LLG2T were opened for 9 and 10 days, respectively, over two consecutive weeks, and in August, traps on all three plots were opened for 6-8 days over two weeks. Traps were checked each morning, and checked again in the afternoon if temperatures exceeded 38 °C.

2.4 SAMPLING: NOOSING

Noosing, catching reptiles with nooses or by hand, was conducted to document the presence of reptilian species that were active on the surface during daylight hours and to estimate abundance and survivorship of the more common reptilian species. Twenty-two plots were sampled at least once between 1991 and 1995, inclusive (Appendix A). In 1991 and 1992, the three trapping-study plots (Figure 3) were sampled using noosing techniques in addition to trapping. In addition, plots COL5T, LLG5C, LLG7T, LG3C, LG6T, and LG7T were sampled (Figure 2). In 1993, the geographic scope of the Site Characterization Effects Program was reduced in response to changing construction plans (i.e., potential impacts), and only the Creosotebush-Wolfberry-Hopsage vegetation association was sampled using noosing procedures. Plots LA3T and COL2T were dropped from the noosing study, but an additional eight plots were established in Creosotebush-Wolfberry-Hopsage habitats, making a total of nine noosing plots (Figure 5 and Appendix A). Five of the new plots were selected in anticipation of monitoring specific impacts (LLG5T, MASH, NPORT-1, SWEX, BPIT), and three plots were established for controls (LLG4C, LLG8C, and FRAN). In 1994, sampling locations were similar to those of 1993, except that NPORT-1 was removed due to expansion of the Exploratory Studies Facility (North Portal), and NPORT-2 was established approximately 500 m south of NPORT-1. In 1995, the study design changed again in response to changing construction plans and activities. Three plots

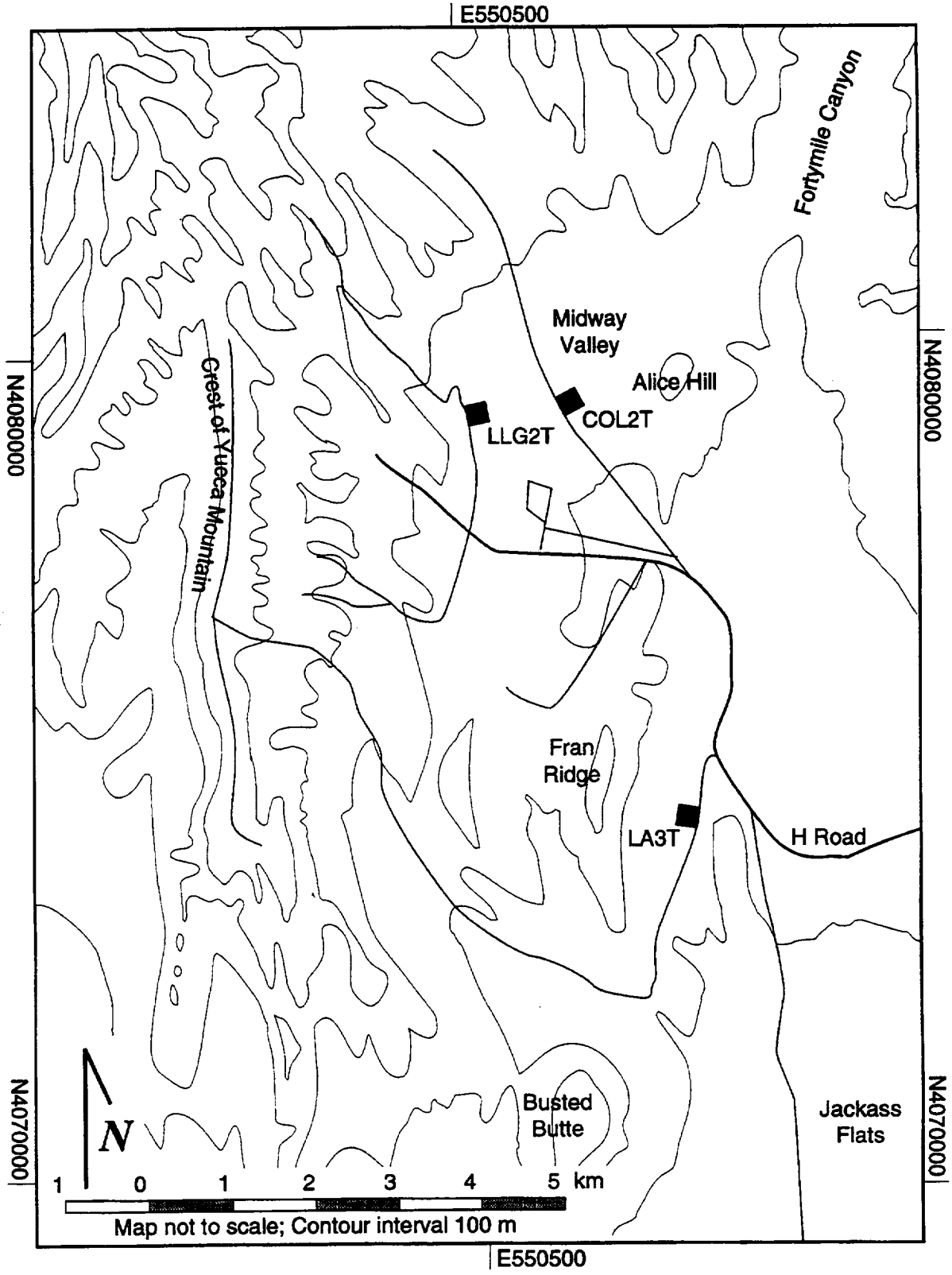

Figure 3. Location of the three reptile trapping plots at Yucca Mountain, Nevada.

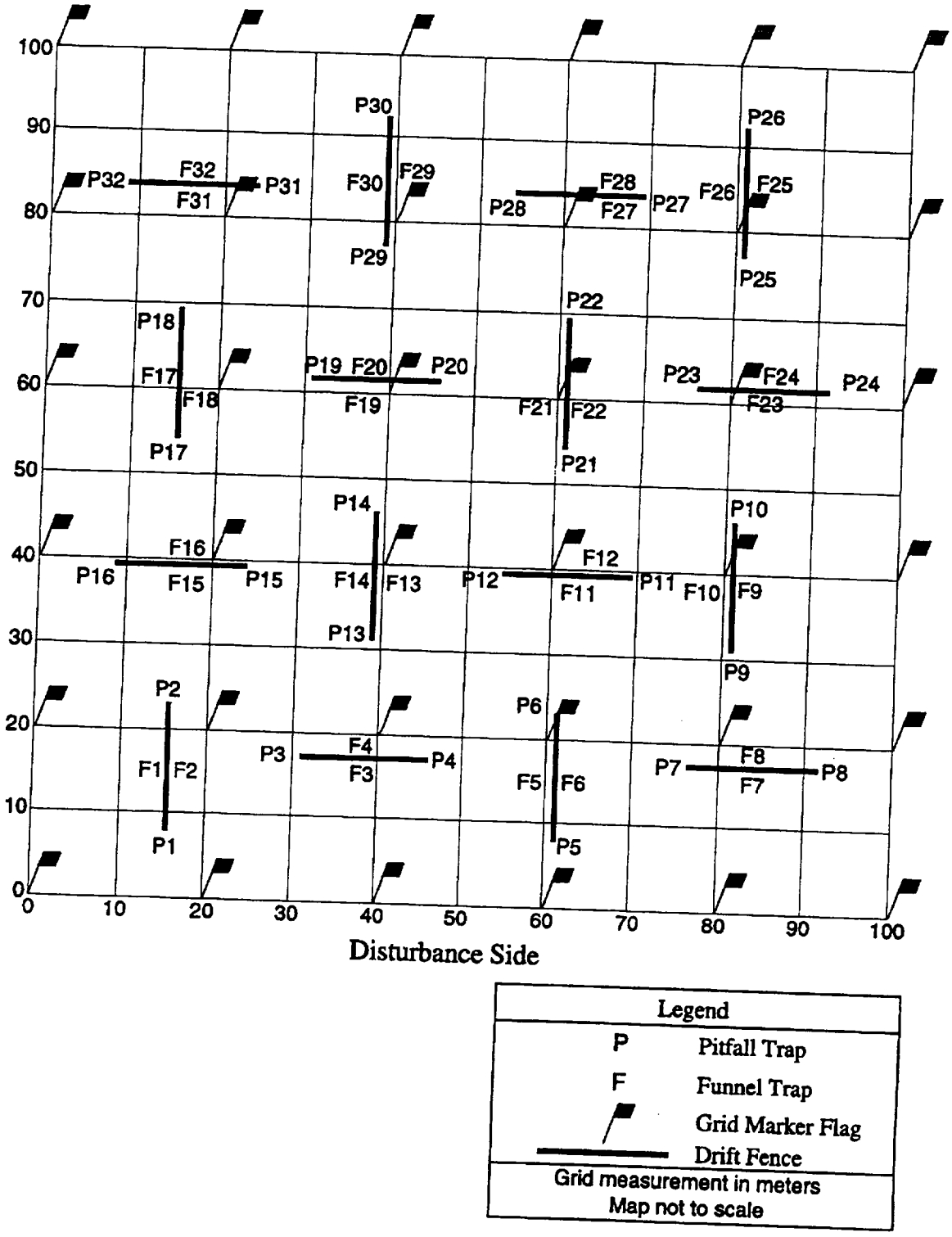

Figure 4. Generalized layout of pitfall traps, funnel traps, and drift fences used on three reptile trapping plots at Yucca Mountain, Nevada. Layout differed slightly among plots depending on local topography and vegetation.

Table 1. Generalized schedule of trapping and noosing on 22 plots at Yucca Mountain, Nevada. Presenting these data in this generalized format obscures irregularities in the sampling schedule (e.g., sampling during months was conducted over time intervals of 1 to 22 days), and readers are cautioned to reference the sampling schedule in Appendix B.

Date	Trapping			Noosing																						
	COL	LA	LLG	COL		LA	LG			LLG																
	2T	3T	2T	2T	5T	3T	3C	6T	7T	5C	7T	2T	MASH	SWEX	4C	5T	8C	FRAN	BPIT	NP1	NP2	11T	FF2C	FF5C	FF6C
Jun-91		x	x			x						x														
Jun-91		x	x			x						x														
Aug-91	x	x	x	x		x						x														
Sep-91	x	x	x			x																				
Jun-92	x	x	x	x		x						x														
Sep-92	x	x	x	x	x	x	x	x	x	x	x	x														
Mar-93			x									x	x	x	x	x	x	x	x	x						
May-93	x	x	x									x	x	x	x	x	x	x	x	x						
Oct-93												x	x	x	x	x	x	x	x	x						
Mar-94												x	x	x	x	x	x	x	x		x					
May-94	x	x	x									x	x	x	x	x	x	x	x		x					
Oct-94												x	x	x	x	x	x	x	x		x					
Apr-95															x	x	x	x	x		x	x				
May-95	x	x	x												x	x	x	x	x			x	x	x	x	

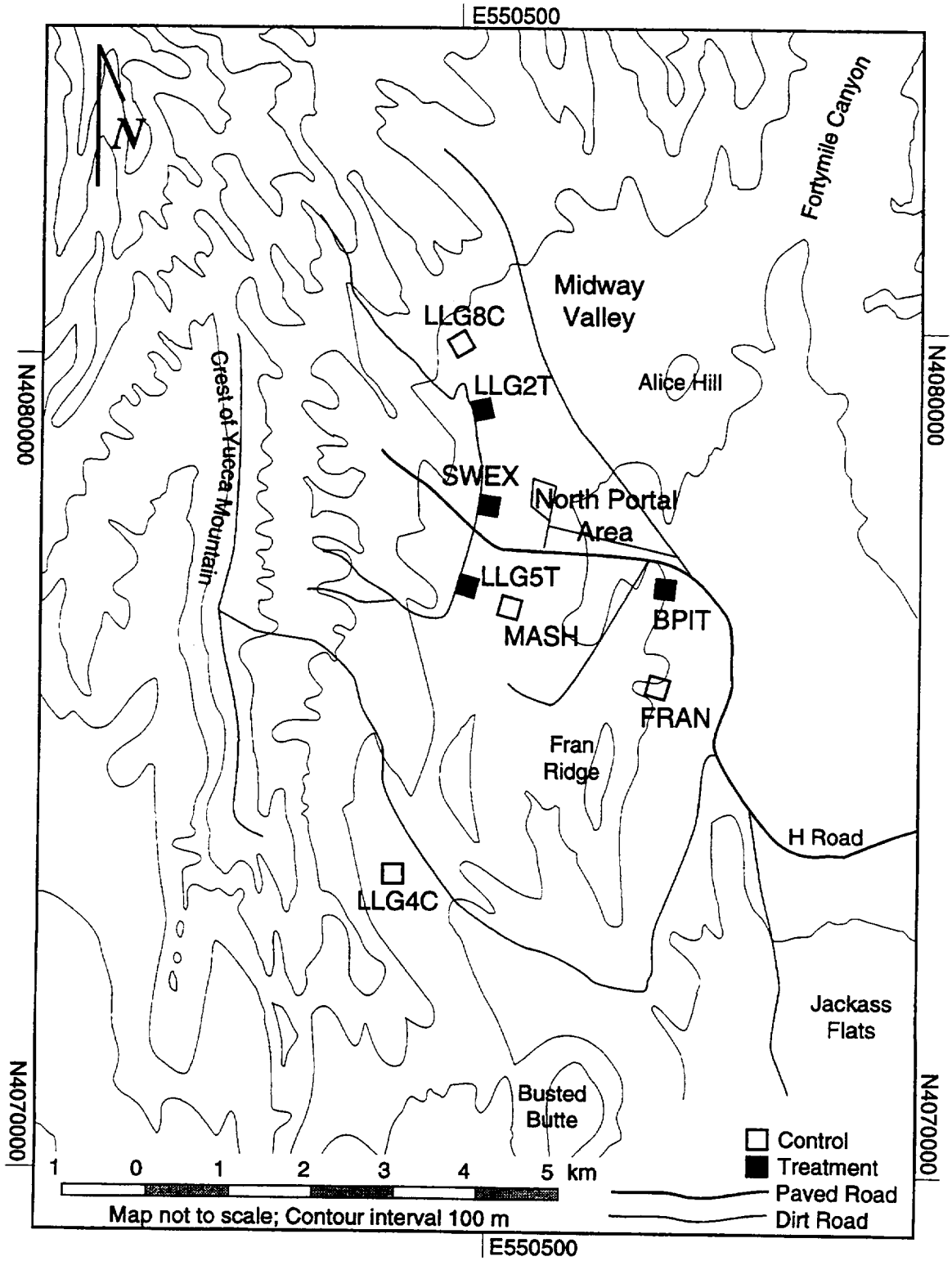

Figure 5. Location of nine reptile sampling plots at Yucca Mountain, Nevada, sampled from 1992 to 1995 using noosing techniques.

(LLG2T, MASH, and SWEX) were discontinued because of changes in construction activities. One new plot (LLG11T) was established adjacent to the expected new storage site for mine tailings, and three new plots (LLGFF2C, LLGFF5C, and LLGFF6C) were established on the northern flank of Little Skull Mountain to provide more distant (FF = far-field), and potentially less impacted, controls (Figure 6). These changes were described by EG&G (1992, 1993, 1994).

The noosing schedule changed within and among years (Table 1 and Appendix B). In 1991, the three trapping plots were sampled using noosing techniques once on plot COL2T and twice on plots LA3T and LLG2T. In 1992, sampling was conducted twice on these three plots. The six plots established in 1992 were sampled for the first time in September. In 1993 and 1994, noosing was conducted three times per year on the nine noosing plots. In 1995, noosing was conducted once on five plots (NPORT-2, LLG2T, LLGFF2C, LLGFF5C, and LLGFF6C) and twice on six plots (LLG4C, LLG5T, LLG8C, LLG11T, BPIT, and FRAN).

In 1991 and 1992, noosing sessions were conducted in early summer (early June) to estimate spring reproduction and again in the fall (late August through mid-September) to estimate summer survival and to mark individuals prior to hibernation. In 1993 and 1994, noosing sessions were conducted in the early spring (late March) to estimate overwinter survival, as well as in early summer (early and late May) and fall (throughout October). In 1995, noosing was conducted in the spring (late March through early April) and again in summer (early May).

In 1991 and 1992, noosing sessions consisted of three to five, generally consecutive, days of sampling. However, as described by Pacheco (1996) for two genera of caimans (Reptilia: Crocodylidae), lizards in this study appeared to become adversely conditioned to the noosing procedures and more frequently avoided capture. Therefore, in 1993 and thereafter, the noosing procedure was modified in an attempt to reduce this avoidance behavior by generally noosing on two non-consecutive days per week over a two-week period (e.g., Monday and Wednesday of one week, and Tuesday and Thursday of the next).

On the first day of sampling on LA3T, COL2T, and LLG2T (the trapping and noosing plots), plots were sampled by noosing and the traps were opened. Thereafter, traps were left open for the duration of the sampling session. On the following mornings, these plots were sampled using noosing techniques and animals were released from the traps. On different occasions, animals were released from the traps before, after, or during noosing. Animals captured in traps were paint-marked and not recaptured that day with nooses.

Plots were sampled by one to four observers systematically searching the plot by walking back and forth on 10-m-wide strips catching animals with nooses or by hand. Nooses were made of black surgical thread that was either attached to a stout wire that extended 5 cm beyond the end of a 91.5- by 0.9-cm wooden dowel (Medica et al. 1971) or attached to a fishing pole. Searching continued each day until two consecutive passes were made across the plot without observing any unmarked (i.e., not bearing the paint-mark of the day) side-blotched lizards (*Uta stansburiana*).

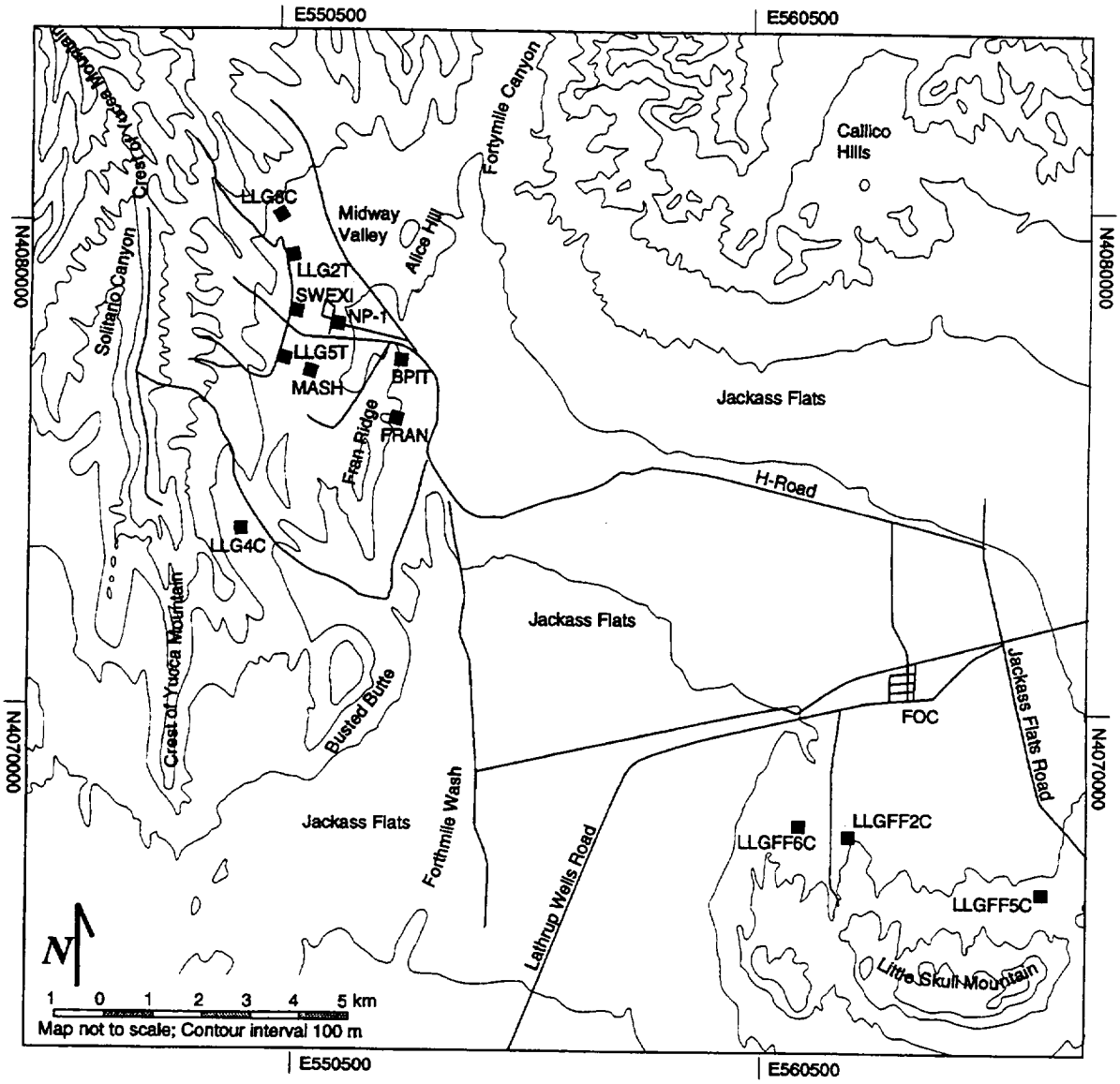

Figure 6. Location of the three reptile noosing plots established in 1995 on the northern flank of Little Skull Mountain in relation to the original nine plots at Yucca Mountain, Nevada.

2.5 SAMPLING: BELT TRANSECTS

The 1991 reptile sampling design included only three plots, all of which were considered treatment plots because they were adjacent to potential sources of impact. To increase the credibility of data inference, the project was expanded in 1992 to include additional plots with differing levels of disturbance (high, low, and none). However, because noosing was labor-intensive and expensive, another method for documenting the abundance of lizards was sought. Therefore, in June 1992, an observation-based, lizard-counting method was implemented to be used as an index of lizard abundance.

Observations of lizards were made on 12 plots in three vegetation associations (LLG, COL, and LG) and excluded LA (Appendix A). The plots included two of the trapping plots (COL2T, and LLG2T) so that the index could be compared to, or standardized with, results of noosing and trapping. Eleven plots were sampled on June 10, 11, and 12, 1992. On the first day, LLG2T, LLG8C, COL2T, COL4C, COL5T, LG3C, LG4C, and LG6T were sampled once, and LLG7T was sampled twice. On the second day, LLG8C and COL5T were not sampled, but LG7T and COL3C were added, COL2T was sampled twice, and LLG2T was sampled three times. On the last day, plots LG3C and LG4C were not sampled, but plots LLG2T, LLG8C, and COL2T were sampled twice. After three days of sampling, all plots were sampled at least twice, and some as many as six times. On September 18, 1992, plots LLG7T, LG3C, and LG7T, as well as a new plot, LLG5C, were sampled. Multiple sampling provided data from which to estimate temporal variability.

One-hectare reptile sampling plots were divided into five contiguous 20- by 100-m strips. Each 20-m-wide strip, or transect, was sampled by three to five observers walking abreast. One pass was made across each transect, and the total time required to walk all five transects (one plot) was approximately 30 to 40 minutes. Counts were made of the number of adult and juvenile animals of each species. On COL2T and LLG2T, previously paint-marked lizards were noted.

2.6 SAMPLING: OPPORTUNISTIC

On approximately 10 occasions between 1991 and 1995, and generally in March, April, and May, when days were warm and the nights cool, scientific personnel drove at night on some of the dirt and paved roads in the vicinity of Yucca Mountain and throughout Jackass Flats looking for reptiles. They drove at approximately 40 km per hour (25 mph) watching in the light of the headlamps. Observations generally began shortly after sunset and lasted for one to two hours. Some of the animals observed were collected and included in the Yucca Mountain vertebrate collection. Few records were made of reptiles that were captured and released. However, animals that were released were believed to be relatively common species (e.g., glossy snake, *Arizona elegans*; longnose snake, *Rhinocheilus lecontei*; and sidewinder, *Crotalus cerastes*), and personnel were specifically attempting to collect and preserve uncommon species or species previously undetected at Yucca Mountain.

On approximately five occasions in July 1994, scientific personnel attempted to catch desert night lizards (*Xantusia vigilis*). These lizards are habitat specialists and are usually found under the bark and inside the dead limbs and trunks of Yucca plants (e.g., joshua trees, *Yucca*

brevifolia; and other *Yucca* species). However, at the Nevada Test Site, they are only known to occur in dead Mojave yucca (*Yucca schidigera*; Tanner and Jorgensen 1963), and despite their efforts, Tanner and Jorgensen (1963) did not find them in joshua trees. Sampling was conducted in the vicinity of plot COL5T by setting five glue-traps (approximately 20 cm square) on the horizontal trunks of dead joshua trees and in the crotch of branches of live trees. Traps were set in the evening and checked the following morning.

2.7 SAMPLING: ANECDOTAL OBSERVATION

Staff biologists made casual observations of reptiles while engaged in other field activities. Some of the reptiles were collected and preserved, but no record was made of most observations. However, chuckwalla (*Sauromalus obesus*) was listed by the U.S. Fish and Wildlife Service as a Category II candidate species from 1992 to 1995, and personnel were encouraged to record sightings of this species because little was known about its abundance and distribution at Yucca Mountain. Observations of chuckwalla in the Yucca Mountain area were recorded from April 1993 to June 1995. Data recorded included location; habitat description; age class (juvenile or adult, based on size and color patterns); and in some cases, behavior.

2.8 STATISTICAL METHODS

The number of animals of each species captured (the minimum number known alive) at each sampling session were tallied and presented in appendices. Summary statistics were taken across sessions and plots within habitat associations. When calculated in this manner, these averages estimate the expected number of animals per plot in each habitat association. However, they obscure differences within years and multi-year trends, and while differences such as these may have been important to understanding the ecology of these reptiles, trend estimates could not be calculated for most species because sample sizes were too small.

Naive densities were estimated as the number of individuals captured on the 1-ha plots. Mark-release-recapture methods were used during the field work, but this information was not used to estimate population size (e.g., using program CAPTURE; Otis et al. 1978) because the number of animals captured was usually too low to make reliable estimates and because recapture rates generally were too low. In addition, lizards appeared to be sensitive to local weather conditions, altering their behavior from minute to minute, and therefore altering capture probabilities within (and among) sampling days in violation of the assumptions of the model. The variation in capture and recapture probabilities, in combination with the generally small number of lizards captured, could confound population estimates by affecting recapture rates, and therefore population size estimates, in ways that would be difficult to interpret.

Relative abundance and relative density estimates were based on density estimates. The term "common" was defined as average densities of greater than approximately 5 animals per hectare. "Uncommon" was applied to populations with average densities of 1-5 ha^{-1}, and "rare" was used to describe average densities of less than approximately 1 ha^{-1}.

To estimate the total number of species that might inhabit the Yucca Mountain area, and by implication, the number of species that might be present but not detected in these sampling

efforts, a species-accumulation graph was constructed by plotting the cumulative number of species caught against sampling effort (estimated as the number of days spent sampling on plots). For the purposes of this model, species accumulation started when formal reptile sampling began in June 1991; therefore, at time zero, three species had already been detected. After the initial three, species captured on plots were included in the model on the day they first appeared in the data. Because anecdotal sampling-effort could not be quantified, species that were first detected through anecdotal observation (e.g., road kills) entered the model on the nearest plot-sampling day. A curve was fit to the data using non-linear procedures in SYSTAT (Wilkinson 1989) by fitting the data to the general curve $y = a + b \ln (x)$.

Determining susceptibility of reptiles to capture using different methods (pitfall traps, funnel traps, and nooses) was complicated by differences in sampling effort using these three sampling methods. To estimate susceptibility, the number of animals captured using each sampling method was standardized by the amount of effort spent using that method. This was done by dividing the total number of animals of each species captured per sampling method by the number of days that sampling method was used. These figures, the number of individuals of each species captured per day per method, were used to calculate the relative frequency of capture by each method. This was done by dividing the number of individuals of each species captured per day per method by the total number of individuals of each species captured per day. Relative frequency of capture per method was assumed to measure susceptibility to capture by that method.

3. RESULTS

3.1 GENERAL

Combined, the reptile sampling efforts in the vicinity of Yucca Mountain resulted in 6,959 captures of 3,405 individuals and documented the presence of 27 (possibly 28) species which included 12 lizards, 14 or 15 snakes, and 1 tortoise (Table 2 and Appendix C). The pitfall and funnel trapping survey documented the presence of 18 reptilian species, including 8 species of lizards and 10 species of snakes (Tables 2, 3, and Appendix D). The noosing survey documented the presence of 16 reptilian species, including 7 lizards and 9 snakes (Tables 2, 3, and Appendix E). The recorded anecdotal observations added two lizards, two (possibly three) snakes, and one tortoise (Table 2). The twenty-eighth species, the distinctively marked ringneck snake (*Diadophis punctatus*), was probably seen, but none were captured. Results from more detailed studies of desert tortoise (*Gopherus agassizii*) were presented elsewhere (CRWMS M&O 1995, 1996b, 1996c). One or more specimens representing 27 species were collected and preserved for voucher specimens (Appendix F).

3.2 TRAPPING (PITFALL AND FUNNEL)

The trapping survey documented the presence of 18 species in three habitat types at Yucca Mountain (Table 3). Assuming that this sampling technique was unbiased with respect to species, only side-blotched lizards and western whiptail lizards (*Cnemidophorus tigris*) were relatively common. While these two species were of approximately equal abundance in each habitat, they were both less common in Creosotebush-Bursage and Creosotebush-Wolfberry-Hopsage habitat types (14-20 ha^{-1}) than in the Blackbrush habitat type (25 ha^{-1}, Table 3). Banded gecko lizards (*Coleonyx variegatus*) and coachwhip snakes (*Masticophis flagellum*) were uncommon, with approximately equal abundance (mean = 1-2 ha^{-1}) in all three habitat types (Table 3). The remaining 14 species were rare, generally averaging fewer than 1 ha^{-1} (Table 3).

All species were not captured in all habitats, and although it was possible to analyze habitat preferences, the small number of individuals of most species captured makes this comparison questionable and of limited value. In addition, because sampling methods were not consistent (e.g., trapping and noosing on LLG2T), differences in behavioral responses by the animals may have confounded the results.

One rare species was trapped that was not observed using other methods. After five years of sampling, a single Gilbert's skink lizard (*Eumeces gilberti*) was captured in a funnel trap on plot LLG2T. This record extends the reported distribution of this species, filling a gap between more northern locations (Pahute Mesa area) on the Nevada Test Site (Medica et al. 1990) and locations to the south and west (Spring Mountains and Grapevine Peak) off the Nevada Test Site (Rogers and Fitch 1947). In addition to extending the known range, this observation appears to be unusual because Gilbert's skink lizard, when found at this elevation (1,130 m) in the desert, usually occurs in riparian habitats.

Table 2. Relative abundances of reptile species recorded at or near Yucca Mountain, Nevada. Estimates based on four sampling methods: pitfall and funnel trapping (Trap), nooses or by hand (Noose), belt transects (Belt), and anecdotal observation (Anec). Abundance was recorded as common (C, > 5 ha^{-1}), uncommon (U, 1-5 ha^{-1}), rare (R, < 1 ha^{-1}), observed but no abundance estimate (X), and expected but not observed (O).

Taxonomic Group / Species	Common Name	Sampling Method				
		Traps	Noose	Belt	Anec	Not-Obs
Order Testudines						
Family Testudinidae						
Gopherus agassizii	desert tortoise			X	X	
Order Squamata						
Suborder Sauria						
Family Crotaphytidae						
Crotaphytus insularis	desert collared lizard		R	R	U	
Gambelia wislizenii	longnose leopard lizard	R	R-U	R	X	
Family Iguanidae						
Dipsosaurus dorsalis	desert iguana				U	
Sauromalus obesus	chuckwalla		R		C	
Family Phrynosomatidae						
Callisaurus draconoides	zebratail lizard	R			C	
Phrynosoma platyrhinos	desert horned lizard	R-U	U	U	U	
Sceloporus graciosus	sagebrush lizard					O
Sceloporus magister	desert spiny lizard	R-U	R		X	
Sceloporus occidentalis	western fence lizard				R	
Uta stansburiana	side blotched lizard	C	C	U-C	C	
Family Gekkonidae						
Coleonyx variegatus	western banded gecko	U			X	
Family Xantusiidae						
Xantusia vigilis	desert night lizard					O
Family Teiidae						
Cnemidophorus tigris	western whiptail	C	U-C	C	C	
Family Scincidae						
Eumeces gilberti	Gilbert's skink	R			X	
Eumeces skiltonianus	western skink					O
Suborder Serpentes						
Family Leptotyphlopidae						
Leptotyphlops humilis	western blind snake					O
Family Colubridae						
Arizona elegans	glossy snake				X	
Chionactis occipitalis	western shovelnose snake	R			X	
Diadophis punctatus	ringneck snake				?	?
Hypsiglena torquata	night snake	R			X	
Lampropeltis getula	common kingsnake	R	R		X	
Masticophis flagellum	coachwhip	R-U	R	R	X	
Masticophis taeniatus	striped whipsnake		R		X	
Phyllorhynchus decurtatus	spotted leafnose snake				X	
Pituophis melanoleucus	gopher snake	R	R	R	X	
Rhinocheilus lecontei	longnose snake	R-U	R		X	
Salvadora hexalepis	western patchnose snake	R	R	R	X	
Sonora semiannulata	ground snake	R-U	R	R	X	
Tantilla hobartsmithi	southwestern blackhead snake	R			X	
Trimorphodon biscutatus	lyre snake					O
Family Viperidae						
Crotalus cerastes	sidewinder		R		X	
Crotalus mitchellii	speckled rattlesnake	R	R	R	X	

Table 3. Average naive densities (number per ha) of reptiles at Yucca Mountain, Nevada, estimated in four habitat types (LG, *Lycium - Grayia*; LA, *Larrea - Ambrosia*; COL, *Coleogyne*; LLG, *Larrea - Lycium - Grayia*) using trapping (pitfall and funnel) and noosing (noose and hand). For each habitat and each method, estimates were based on different levels of effort.

Suborder Family Species	Common Name	Mean Number Captured ha^{-1}						
		Trapping			Noosing			
		LA	COL	LLG	LG	LA	COL	LLG
Sauria								
Crotaphytidae								
Gambelia wislizenii	longnose leopard lizard	0.8	0.4			2.5	1.0	0.2
Crotaphytus insularis	desert collared lizard				3.0		0.2	0.6
Phrynosomatidae								
Callisaurus draconoides	zebratail lizard		0.1					
Phrynosoma platyrhinos	desert horned lizard	0.6	1.7			2.5	3.8	1.4
Sauromalus obesus	western chuckwalla							0.1
Sceloporus magister	desert spiny lizard	1.4	0.1	0.1				0.6
Uta stansburiana	side-blotched lizard	14.0	24.9	13.9	55.3	5.7	52.6	32.7
Gekkonidae								
Coleonyx variegatus	western banded gecko	1.6	2.6	1.6				
Teiidae								
Cnemidophorus tigris	western whiptail	16.6	25.4	19.9	0.3	9.3	6.0	2.6
Scincidae								
Eumeces gilberti	Gilbert's skink			0.1				
Serpentes								
Colubridae								
Chionactis occipitalis	western shovelnose snake	0.7						
Hypsiglena torquata	night snake		0.4	0.1				
Lampropeltis getula	common kingsnake	0.1		0.1				0.2
Masticophis flagellum	coachwhip	0.6	1.0	2.0	0.3		0.2	0.3
Masticophis taeniatus	striped whipsnake						0.2	
Pituophis melanoleucus	gopher snake	0.1	0.4	0.2				0.3
Rhinocheilus lecontei	longnose snake	0.7	0.4	1.3				0.1
Salvadora hexalepis	western patchnose snake	0.3	0.1	0.2				0.3
Sonora semiannulata	ground snake	0.3	1.0	1.6				0.2
Tantilla hobartsmithi	southwestern blackheaded snake		0.1	0.4				
Viperidae								
Crotalus cerastes	sidewinder							0.1
Crotalus mitchellii	speckled rattlesnake	0.1		0.2				0.1

3.3 NOOSING

The noosing survey documented the presence of 16 species in four habitat types at Yucca Mountain (Table 2). Assuming that this sampling technique was unbiased with respect to species, side-blotched lizards and whiptail lizards were common, but of unequal abundance in the three lower-elevation habitats (Table 3). Whiptail lizards were not captured during limited sampling (Appendix B) on three plots in the higher-elevation Wolfberry-Hopsage habitat. On one plot in Creosotebush-Bursage habitat, the densities of side-blotched lizards and western whiptail lizards were approximately 6 and 9 ha^{-1}, respectively (Table 3). In limited sampling of the Blackbrush habitat type, side-blotched lizards (53 ha^{-1}) appeared to be approximately nine times more abundant than western whiptail lizards (6 ha^{-1}). In the intensively sampled Creosotebush-Wolfberry-Hopsage habitat type, side-blotched lizards (33 ha^{-1}) appeared to be approximately 11 times more abundant than western whiptail lizards (3 ha^{-1}).

Results of noosing surveys suggest that three species were uncommon. In the three habitats where they were observed, the estimated density of longnose leopard lizards (*Gambelia wislizenii*) ranged from 0.2 to 2.5 ha^{-1}, and that of desert horned lizards (*Phrynosoma platyrhinos*) ranged from 1.4 to 3.8 ha^{-1} (Table 3). Desert collared lizards (*Crotaphytus insularis*) were uncommon in LG habitats (3 ha^{-1}), and rare in COL (0.2 ha^{-1}) and LLG (0.6 ha^{-1}). The remaining 11 species were rare (< 1 ha^{-1}; Tables 2 and 3).

All species were not captured in all habitat types, and estimated densities were unequal in the habitat where species occurred (Tables 2 and 3). However, detailed analyses of habitat preference were not possible because the numbers caught were generally too low for analysis and the sampling effort, by design, was unevenly distributed among habitats. Sampling effort in LLG included 16 plots, whereas sampling was conducted on only three LG plots (only in September 1992), two COL plots, and one LA plot.

3.4 BELT TRANSECTS

Belt transect surveys, conducted on 12 plots, documented the presence of 11 species (5 lizards, 5 snakes, 1 tortoise) in three habitat associations (Tables 2 and 4). Using this method, side-blotched lizards were the most abundant species. Estimated naive densities for this species ranged from 25 to 41 ha^{-1} in the three habitats (Table 4). Western whiptail lizards were the second most common species in all three habitats, with estimated densities ranging from 1 to 5 ha^{-1}. Desert horned lizards were uncommon in the COL habitat type (1.2 ha^{-1}), rare in LLG (0.1 ha^{-1}), and not observed in LG habitats. The other eight species were rare, with estimated naive-densities ranging from 0.1 to 0.3 ha^{-1}, and each was only observed in one habitat type (Table 4).

Side-blotched lizards appeared to be more abundant in the high-elevation LG habitat than in either COL or LLG, although its abundance may not have differed significantly from that in LLG (Table 4). Western whiptail lizards, by contrast, appeared to be least abundant in the LG habitat type (Table 4).

Table 4. Average naive densities (number per ha) of reptiles at Yucca Mountain, Nevada, estimated in three habitat types (LG, *Lycium-Grayia*; COL, *Coleogyne*; LLG, *Larrea-Lycium-Grayia*) using visual observations on belt transects during June and September 1992.

Order	Family	Species	Common Name	Habitat Type		
				LG	COL	LLG
Testudinies						
	Testudinidae					
		Gopherus agassizii	desert tortoise		0.1	
Sauria						
	Crotaphytidae					
		Crotaphytus insularis	desert collared lizard	0.2		
		Gambelia wislizenii	longnose leopard lizard		0.3	
	Phrynosomatidae					
		Phrynosoma platyrhinos	desert horned lizard		1.2	0.1
		Uta stansburiana	side-blotched lizard	40.6	25.2	36.7
	Teiidae					
		Cnemidophorus tigris	western whiptail	1.3	3.5	5.4
Squamata						
	Colubridae					
		Masticophis flagellum	coachwhip	0.1		
		Pituophis melanoleucus	gopher snake		0.1	
		Salvadora hexalepis	western patchnose snake			0.2
		Sonora semiannulata	ground snake		0.1	
	Viperidae					
		Crotalus mitchellii	speckled rattlesnake			0.1

3.5 OPPORTUNISTIC AND ANECDOTAL OBSERVATIONS

Few records were made of reptiles observed as road-kills or while searching roads at night. However, these records support the idea that sidewinder snakes and glossy snakes were not uncommon, at least in the LA habitat type. Other species recorded from roads included speckled rattlesnakes (*Crotalus mitchellii*) and longnose snakes. Observations of reptiles on roads, gleaned from personal journals, included western patchnose snake (*Salvadora hexalepis*), gopher snake (*Pituophis melanoleucus*), longnose snakes, and common kingsnake (*Lampropeltis getula*).

Directed searches were initiated only for desert night lizards, and only on joshua trees in the higher-elevation COL habitat. None were caught. While this lizard is expected in joshua trees, it has never been recorded in association with this plant at the Nevada Test Site, and this species was not recorded using any sampling method at Yucca Mountain.

Observations of 51 chuckwallas in the vicinity of Yucca Mountain were recorded between April 1993 and June 1995 (Figure 7). Most of the records were made in 1993 ($n = 29$) and 1994 ($n = 18$); only four records were made in 1995. The decline in the number of records reflects declining numbers of field personnel and declining reporting rather than declining numbers of lizards. Of the 51 sightings reported, 22 were of adults, 26 were of juveniles and 3 were not classified. Observations of chuckwallas were most frequently recorded in rocky areas (47 of 51 records): either rocky hillsides ($n = 25$), rocky ridge-tops ($n = 17$) or rocky washes ($n = 5$). Of four chuckwalla observation records that did not specifically state rocky habitat, three were in washes. Two of these three observations were probably made in rocky washes, although the third may have been from a sandy area (Crater Flats, southeast of Black Cone). The Crater Flats record was not specific, and this observation could not be verified, but there are rocky outcrops along washes southeast of Black Cone. The fourth western chuckwalla, reported from a bajada in upper Midway Valley (plot LLG8C, Figure 2), was injured and had puncture wounds consistent with raptor talons. It may have been captured by a raptor and carried away from a rocky area before being dropped near the location where it was observed.

A single spotted leafnose snake (*Phyllorhynchus decurtatus*) was documented at Yucca Mountain. This animal was captured and photographed on study plot LA3T on June 11, 1991. No data were recorded, but from the photographs, the specimen appeared to be an adult.

Desert iguana lizards (*Dipsosaurus dorsalis*) appeared to be rare in the study area on the east side of Yucca Mountain, and none were captured on the study plots. One was collected in 1992 on the road near plot LA3T (Appendix F). However, this species was frequently sighted in Crater Flats on the west side of the mountain.

Animal specimens collected by Yucca Mountain personnel (generally salvaged along roadways) were freeze-dried ($n = 29$), alcohol-preserved ($n = 24$), or frozen and not yet prepared ($n = 6$) (Appendix F). Of the 29 freeze-dried specimens (7 lizard and 12 snake species), 28 were collected near Yucca Mountain, and one desert spiny lizard (*Sceloporus magister*) was collected elsewhere on the Nevada Test Site (Mercury). Of the 24 alcohol-preserved specimens, 17 were

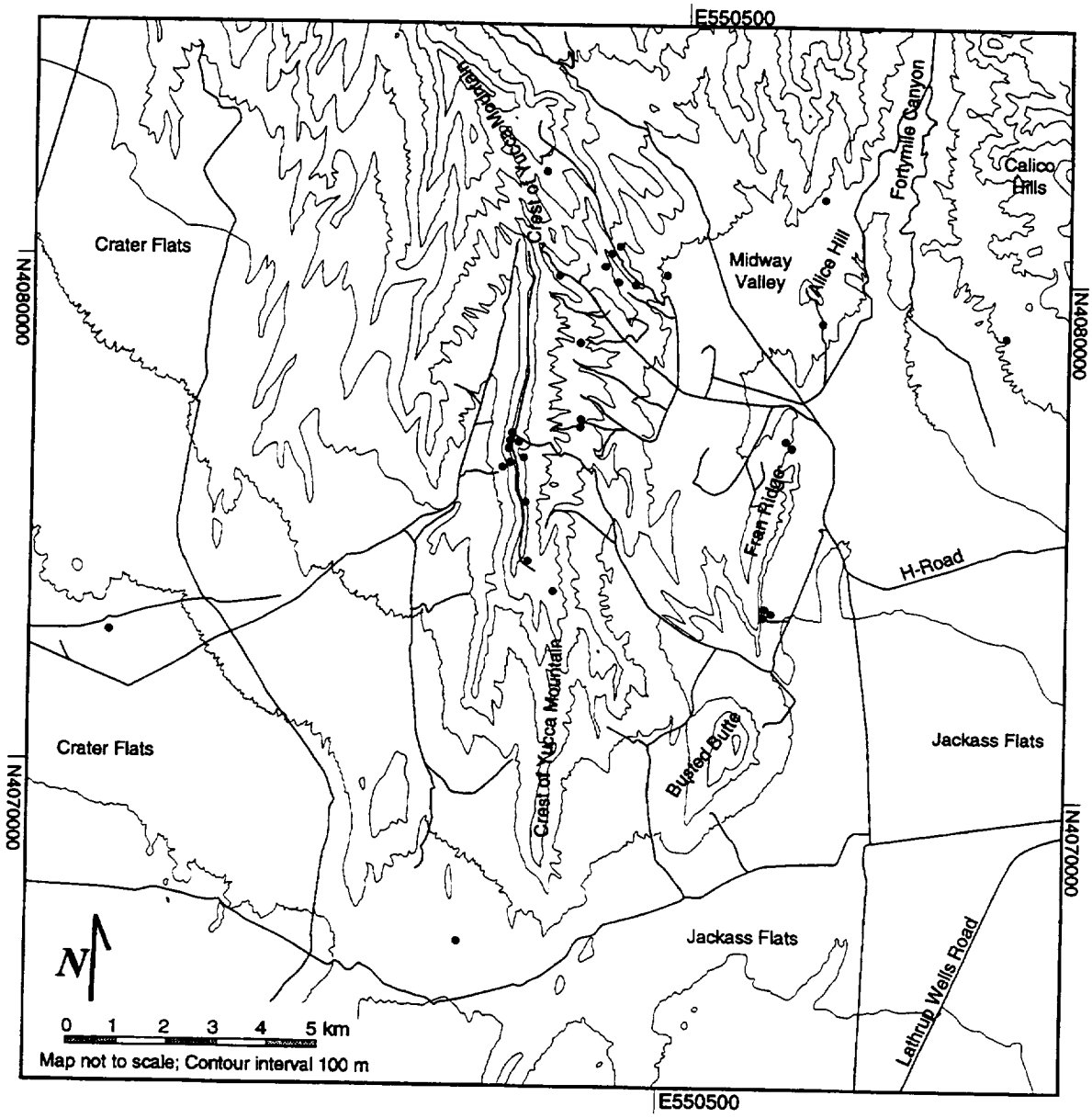

Figure 7. Location of chuckwalla (*Sauromalus obesus*) observation records (•) in the vicinity of Yucca Mountain, Nevada.

collected in the vicinity of Yucca Mountain. Five of the remaining seven alcohol-preserved specimens were collected on Jackass Flats Road between Mercury and Little Skull Mountain, the sixth specimen was collected in Fortymile Canyon, and the last was collected on Pahute Mesa Road. Another species, spotted leafnose snake, was documented with photographs. In total, these collections documented the presence of 27 species (12 lizards, 14 snakes, and 1 tortoise) at Yucca Mountain, and they include all but 6 of the species thought to exist in the Yucca Mountain region. These collections added 4 species: desert iguana lizard, western fence lizard, glossy snake, and spotted leafnose snake, to the list of species known to occur at Yucca Mountain.

One additional species, the ringneck snake, was probably observed at Yucca Mountain, but no voucher specimens were collected. In 1992 or 1993, a snake was captured and released on the west side of Tortoise Hill near plot LLG4C. Personnel who made this observation did not know the species, but discussed it later with other personnel more familiar with reptile identification. In early summer 1992, this species was briefly observed by a knowledgeable observer before it escaped under a rock on the west side of Yucca Mountain near the crest. Because this species is distinctive (green dorsum and red venter), these identifications were probably correct.

3.6 SUMMARY

Recapture rates were generally low for all techniques used. Most captured individuals were only observed once (Figure 8), although one side-blotched lizard at plot BPIT was captured 19 times over 1.5 years. Overall, 1,813 of 3,404 (53%) individuals were captured only once, but this overestimates recapture rates for most species because of the relatively high recapture rates for side-blotched lizard (52%) and the large number of individuals of this species captured (2,508). If recapture rates were averaged across species, 76% of individuals evaded recapture. Recapture rates for side-blotched lizard were the highest for any species at Yucca Mountain, but whether the higher recapture rate was due to its behavior, or due to observer persistence, was not known.

Among the snakes, 95% were never recaptured. Individuals of some uncommon species of snakes (western shovelnose snake, *Chionactis occipitalis*; night snake, *Hypsiglena torquata*; common kingsnake; western patchnose snake; southwestern blackhead snake, *Tantilla hobartsmithi*) were never recaptured. Few of the more common snakes were recaptured: 6 of 45 coachwhip snakes, 3 of 16 gopher snakes, and 5 of 22 longnose snake were recaptured.

Species differed in their susceptibility to capture methods (Table 5). Lizards were generally more susceptible to capture in funnel traps or by noosing than by pitfall trapping, and a given species was generally more often caught with nooses or funnel traps, rather than by both methods equally. Three species of lizards were never caught with nooses (zebratail lizard, *Callisaurus draconoides*; western banded gecko lizards, and Gilbert's skink lizards, but two others (desert collard lizards and western chuckwallas) were only captured using this method. Desert spiny lizards and western whiptail lizards were most often captured in traps, and desert horned lizards and side-blotched lizards were most often captured while noosing (Table 5). Snakes were generally most susceptible to capture in funnel traps and (except for western shovelnose snakes and southwestern blackheaded snakes) least susceptible to capture in pitfall traps. Three species of snakes (western shovelnose snakes, night snakes, and southwestern blackheaded snakes) were never captured by noosing or by hand, and two species (striped whipsnake, *Masticophis taeniatus;* and sidewinder snakes) were never captured in traps. Some snake species were captured only in pitfall (southwestern blackheaded snakes) or funnel traps (night snakes).

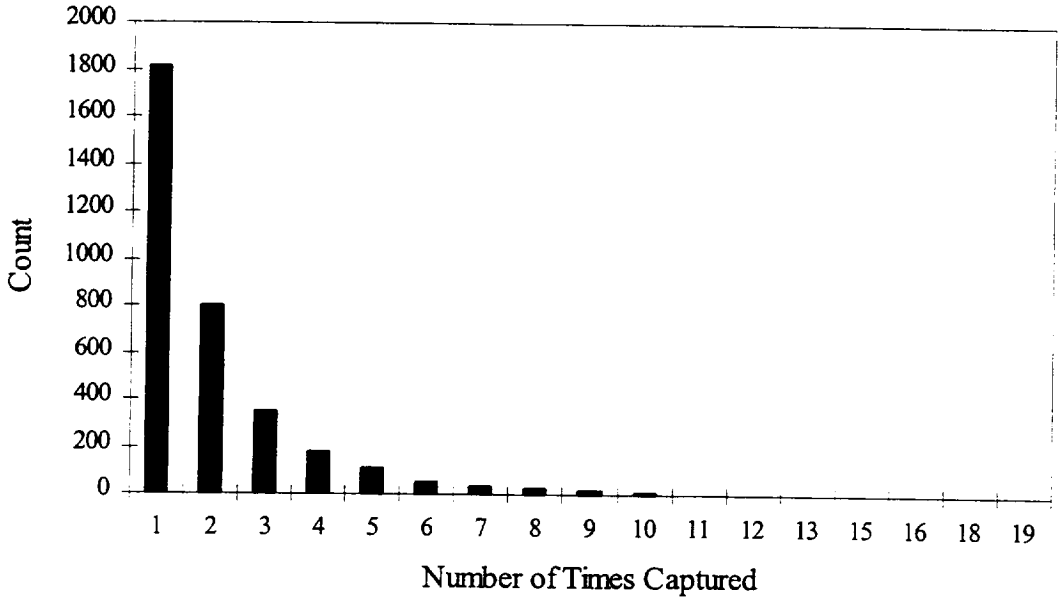

Figure 8. Histogram of the number of times individual reptiles of all species were captured at Yucca Mountain, Nevada. Only *Uta stansburiana* were captured more than 11 times, and only one individual was captured each of 15, 16, 18, and 19 times.

Sampling of the reptile community was generally successful (Figure 9). The accumulation of species was fit by the log-curve

$$c = 5.953 + 4.581 \ln (d); \quad (1)$$

where c = cumulative number of species detected and d = number of days sampling. While log-curves do not asymptote, the curve would likely be very flat by 31 or 32 species, and the time required to document these remaining species would likely be long (approximately 190 days for 30 species, and 300 days for 32 species). The fit of this curve to the data was good (r^2 = 0.994), but the data points appear to asymptote more quickly than the curve, suggesting that the total number of reptilian species at Yucca Mountain may be about 30 rather than the 27 documented here.

A general decline in the number of lizards, especially in the more common side-blotched lizards and western whiptail lizards, was noted (Appendices D and E). While the decline may have been due to natural changes in these populations, the beginning precisely coincided with changing the marking techniques from acrylic paint to xylene-based paint pens. The decline may also have been due to inadvertent habitat modification while sampling or to other sampling effects, or to rainfall patterns.

Table 5. Susceptibility of reptiles to three sampling methods used between 1991 and 1995 at Yucca Mountain, Nevada. The total number captured using each method (N) was scaled by 99 days each of funnel and pitfall trapping and 388 days of noosing to determine mean number captured per day ($\bar{x}$) and relative frequency of capture per method. Cases with small sample sizes should be interpreted carefully.

Suborder / Family / Species	Common Name	N	$\bar{x}$	Relative Frequency of Capture		
				Funnel	Pitfall	Noose
Sauria	lizards					
Crotaphytidae						
Crotaphytus insularis	desert collared lizard	37	0.10			1.00
Gambelia wislizenii	longnose leopard lizard	42	0.19	0.26	0.32	0.42
Iguanidae						
Sauromalus obesus	western chuckwalla	1	<0.01			1.00
Phrynosomatidae						
Callisaurus draconoides	zebratail lizard	1	0.01	1.00		
Phrynosoma platyrhinos	desert horned lizard	94	0.36	0.22	0.22	0.55
Sceloporus magister	desert spiny lizard	25	0.21	0.71	0.24	0.06
Uta stansburiana	side-blotched lizard	5465	18.49	0.18	0.14	0.68
Gekkonidae						
Coleonyx variegatus	western banded gecko	50	0.51	0.56	0.44	
Teiidae						
Cnemidophorus tigris	western whiptail	1031	7.77	0.48	0.41	0.12
Scincidae						
Eumeces gilberti	Gilbert's skink	1	0.01	1.00		
Serpentes	snakes					
Colubridae						
Chionactis occipitalis	western shovelnose snake	6	0.06	0.17	0.83	
Hypsiglena torquata	night snake	4	0.04	1.00		
Lampropeltis getula	common kingsnake	6	0.03	0.66		0.34
Masticophis flagellum	coachwhip	49	0.38	0.87	0.03	0.10
Masticophis taeniatus	striped whipsnake	1	<0.01			1.00
Pituophis melanoleucus	gopher snake	15	0.10	0.82		0.18
Rhinocheilus lecontei	longnose snake	28	0.28	0.92	0.07	0.01
Salvadora hexalepis	western patchnose snake	8	0.07	0.92		0.08
Sonora semiannulata	ground snake	28	0.26	0.66	0.31	0.03
Tantilla hobartsmithi	southwestern blackhead snake	5	0.05		1.00	
Viperidae						
Crotalus cerastes	sidewinder	1	<0.01			1.00
Crotalus mitchellii	speckled rattlesnake	4	0.03	0.61	0.31	0.08

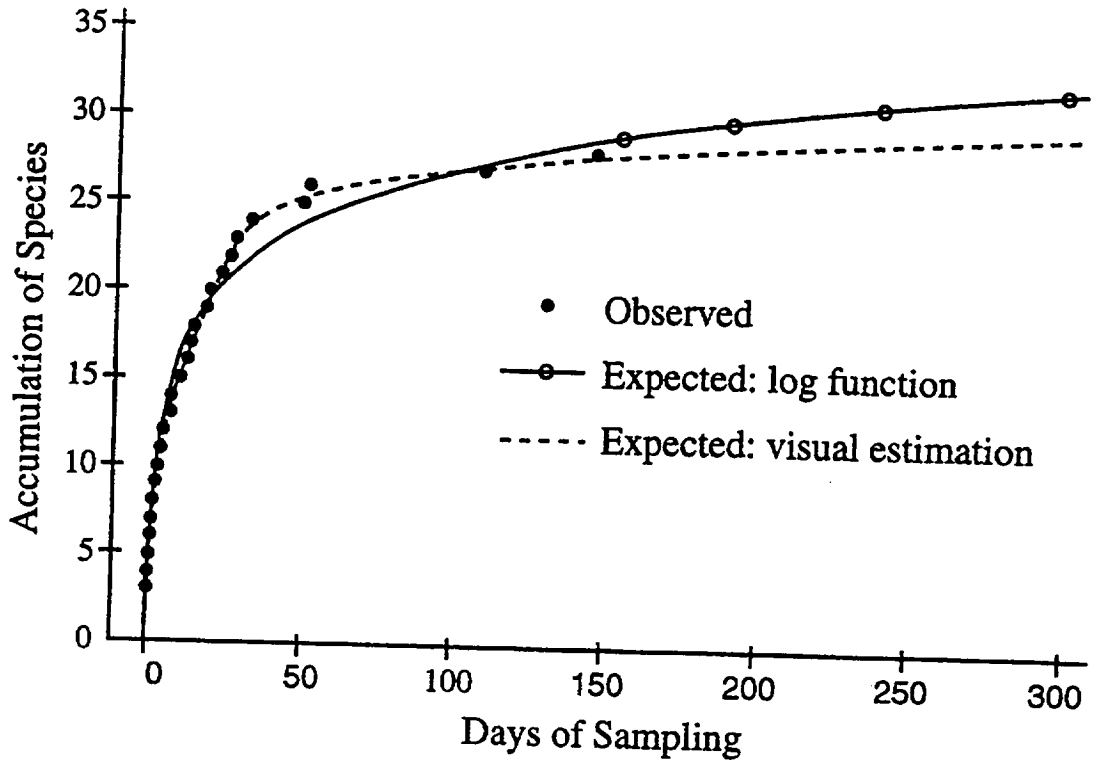

Figure 9. Cumulative number of species observed versus sampling effort at Yucca Mountain, Nevada. Data points were fitted with (1) a log curve of the form $y = a + b \ln(x)$ and (2) a line approximated by visual estimation.

4. DISCUSSION

A number of sampling strategies were applied to obtain a robust list of reptiles occurring at Yucca Mountain that was little biased by differences among sampling methods. Combined, these efforts documented the presence of 12 species of lizards, 14 or 15 species of snakes, and 1 tortoise species (Table 2). Trapping and noosing techniques documented 18 and 17 species, respectively, for a total of 22 species, and other methods added two lizards, two (possibly three) snakes, and one tortoise. Overall, only two species were relatively common (side-blotched lizards and western whiptail lizards), and all other species were uncommon or rare. Two species of special concern, desert tortoise and western chuckwalla, were uncommon at Yucca Mountain, and there was no evidence of change in abundance throughout the study.

Some species previously recorded on the Nevada Test Site were not recorded during these surveys. Some of these species are likely to occur at Yucca Mountain, but others may not. Desert night lizards probably do not occur in the Yucca Mountain area, and the lack of records probably reflects lack of appropriate habitat. This species occurs in association with Yucca plants, but apparently only in association with Mojave yucca on the Nevada Test Site (Tanner and Jorgensen 1963). Absence of this species in joshua trees, if true, suggests that the habitat requirements or habitat preferences of desert night lizards on the Nevada Test Site may be different from other areas.

Ringneck snakes almost certainly occur on Yucca Mountain. In arid locations, this species favors relatively moist north-facing slopes (Verner and Boss 1980), habitats that were not intensively sampled at Yucca Mountain. Of two snakes that were captured and believed to be ringneck snakes, one was observed in this type of habitat. The other snake was observed on the edge of a wash, a more typical desert environment.

Western fence lizards occur on the Nevada Test Site on rocky ledges above valley bottoms and in pinyon-juniper (*Pinus-Juniperus*) habitat (Tanner and Jorgensen 1963). While pinyon-juniper does not occur in the Yucca Mountain study area, rocky ledges do, but these were not systematically sampled.

Western skinks (*Eumeces skiltonianus*) have been recorded in pinyon-juniper habitats on the Nevada Test Site (Tanner and Jorgensen 1963). Lack of appropriate habitat probably accounts for not observing this species, and it probably does not occur at Yucca Mountain.

Western blind snakes (*Leptotyphlops humilis*) probably occur on rocky slopes at Yucca Mountain, but they appear to be very rare (Tanner and Jorgensen 1963). After extensive sampling, a single specimen was recorded at Rock Valley, approximately 30 km southeast of Yucca Mountain (Tanner 1969) in habitat similar to that at Yucca Mountain. Documenting the presence of this species would likely involve considerable effort in the appropriate habitat using trapping techniques.

Lyre snakes (*Trimorphodon biscutatus*), at the northern edge of their range, were suggested by Tanner (1969) to be truly rare at the Nevada Test Site. Its preferred habitat, described by

Stebbins (1966) as rocky hillsides and rocky canyons, was not adequately sampled at Yucca Mountain.

Spotted leafnose snakes were apparently common on the Nevada Test Site (Tanner and Jorgensen 1963), but only one was detected at Yucca Mountain. This species almost certainly occurs in greater abundance at Yucca Mountain than is suggested by this single observation, as a large number of specimens have been collected from Jackass Flats (Tanner 1969). Tanner (1969: 33) stated, "we have found this species to be one of the more common" ... "in those habitats where *Larrea* occurs as part of the vegetative cover." This secretive species is likely present and abundant in the Creosotebush-White Bursage habitat type (Stebbins 1966).

One species, long-tailed brush lizard (*Urosaurus graciosus*), may occur at Yucca Mountain and the Nevada Test Site, but its presence has not been recorded. The preferred habitat of this species is brushy areas with sand (LA), especially in areas with exposed creosotebush roots. This species superficially looks like side-blotched lizards, but is more slender and has a longer tail. Stebbins (1966) uses a tail length of more than twice the snout-vent length as a key character for identifying this species. About 10 side-blotched lizard specimens captured at Yucca Mountain fit this description: snout-vent length longer than 4 cm and tail length at least twice as long as the snout-vent length. These may have been long-tailed brush lizard rather than side-blotched lizards. In addition, one record of a side-blotched lizard had a note suggesting the specimen may have been a western whiptail, two species that superficially should never be confused. It might be possible to mistake a long-tailed brush lizard for a lizard with the coloration and pattern of a side-blotched lizard, but the body form of a western whiptail.

While most of the species present at Yucca Mountain probably have been documented, additional species should continue to be found over time. The species-accumulation graph (Figure 9) suggests that two or three more species may be found in the Yucca Mountain area, but that considerable additional effort would be needed to document them. These three species are probably desert night lizards, ringneck snakes, and lyre snakes.

Inconsistencies in the sampling methods among plots and through time make it difficult to use these data for estimating presence and absence within habitats or to make comparisons among plots and among species. Different methods used during this study provided different results, thus these various techniques, and perhaps others, would be needed to fully document all species that occur in desert environments. However, the intense sampling effort used in this study provided a list of species known to occur at Yucca Mountain and some information on the relative abundances of common species.

Major trends were noted that are similar to those found in three continental lizard faunas by Pianka (1986), where species assemblages consisted of one or a few common species and many rare species. At Yucca Mountain, side-blotched lizards were always most common, and western whiptail lizards or zebratail lizard were generally also common. Among the snakes, none were common, but coachwhip snake, longnose snake, and ground snakes (*Sonora semiannulata*) appeared to be more common than other species.

The trapping data, which was confounded least due to differences in sampling effort, can be used to make provisional comparisons among habitats, but because the treatment of plot LLG2T differed from the treatment of the other two trapping plots (sampling with traps and nooses versus traps only), statistical rigor cannot be applied. However, side-blotched lizards and western whiptail lizards appear to be most common in COL and of approximately equal density in both creosotebush habitats. Desert collared lizards, longnose leopard lizards, and desert horned lizards appear not to occur in LLG, but this is contradicted by noosing data and is likely a result of biases in sampling methods (Table 5). Western shovelnose snakes may only occur in LA, but night snakes and southwestern blackhead snakes probably do not occur in that habitat type. Common kingsnakes may not occur in the COL habitat type.

Estimates of density and relative abundance of species within habitats, based on noosing and trapping, differed. Estimates from noosing suggest that side-blotched lizards and western whiptail lizards were common (generally more than 5 ha^{-1}), but of unequal abundance in each habitat, whereas estimates based on trapping suggest that they were common and of approximately equal abundance in each habitat. Using noosing techniques in LA habitat, side-blotched lizards and western whiptail lizards populations appeared to be about half as dense as estimates of the same populations based on trapping (Table 3). Using noosing techniques in COL and LLG habitat types, the density of side-blotched lizards appeared to be approximately twice, and that of western whiptail lizards appeared to be about one-fifth, of the densities suggested by trapping (Table 3). The two techniques differed in the number of species judged to be uncommon (generally 1 to 5 ha^{-1}). The trapping data suggested that two species were uncommon, whereas the noosing suggested three. The lists of rare species (generally fewer than 1 ha^{-1}) also differed. Noosing techniques documented the presence of four species that were never trapped, and trapping techniques documented the presence of five species that were never noosed (Tables 2 and 3).

Estimates of relative abundance also differed for trapping and noosing. Estimates from trapping suggested that side-blotched lizards were slightly, but consistently, less common in the three main habitat types than were western whiptail lizards (Table 3). However, estimates from noosing suggest that side-blotched lizards were less common than western whiptail lizards only in the LA habitat, and that side-blotched lizards were far more common than western whiptail lizards in COL and LLG habitats (Table 3). The absolute numbers of the other species were too small, and detectability differences among them in the various habitats were too great, to make meaningful relative abundance comparisons.

Sampling in the higher-elevation LG habitats, while inadequate for comparative purposes, suggested that side-blotched lizards are common in that habitat, perhaps with densities similar to those in COL habitat (where they were most abundant).

Generally low recapture rates suggest that most reptiles at Yucca Mountain exhibit a behavioral response to avoid recapture, as it is unlikely that they die or leave the plots the day they are first captured. In particular, it is of note that on the trapping plots, once an animal was captured in one type of trap, it avoided capture in the other kind of trap and also avoided nooses. Animals either continued to live on the plot and avoided capture or were able to successfully navigate the drift fences and exit the plot without recapture. These behavioral responses may have affected the

results from the trapping-only plots differently than they affected the results from the plots that were sampled by trapping and noosing. The response of these animals to capture may have an affect on mark-recapture estimates. Although paint-marking is believed to have no effects on survival of lizards (Jones and Ferguson 1980), paint-marking might have caused the observed response.

In some cases, the different sampling techniques gave conflicting estimates of the relative abundances of species in different habitats. Based on results of noosing and trapping techniques, side-blotched lizards and western whiptail lizards appeared to be most common in COL habitat. However, using observation techniques (that do not require capturing animals for inclusion in the data set), both species appeared to be most common in LLG. While the apparent differences in abundance could be due to structural differences among plots (presence of boulders, washes, etc.), these differences are likely the result of differences in observability and catchability in different habitats. Other differences exist, but because of differences in sampling effort and plot treatments, they are difficult to interpret.

This study provided a list containing most of the reptile species that occur at Yucca Mountain (excluding only the most rare species), and although the information must be interpreted with caution because of changes in methodology, this study also provided some information on the abundance and distribution of reptiles at Yucca Mountain.

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APPENDIX A

PLOT LOCATION AND SAMPLING METHODS.

APPENDIX A

Approximate location (Zone 11 universal transverse mercator, UTM, coordinates based on geodetic datum NAD27) and methods used to sample reptiles from 1991 to 1995 at Yucca Mountain, Nevada.

		Sampling Method			UTM	
Habitat	Plot	Trap	Noose	Visual	Easting	Northing
Coleogyne						
	2T	X	X	X	551900	4079230
	3C			X	552180	4080800
	4C			X	551870	4081170
	5T		X	X	547920	4079500
Larrea-Ambrosia						
	3T	X	X		553210	4074380
Lycium-Grayia						
	3C		X	X	548030	4073920
	4C			X	548270	4073330
	6T		X	X	547600	4076100
	7T		X	X	547590	4074770
Larrea-Lycium-Grayia						
	2T	X	X	X	550670	4074380
	4C		X		549250	4073700
	5C		X	X	549330	4073530
	5T		X		550560	4077060
	7T		X	X	550950	4076000
	8C		X	X	550440	4080110
	11T		X		551760	4077980
	BPIT		X		553060	4077050
	FF2C		X		562140	4067620
	FF5C		X		566180	4066230
	FF6C		X		561040	4067690
	FRAN		X		552900	4075500
	MASH		X		551170	4077000
	NPORT-1		X		551250	4078400
	NPORT-2		X		551250	4077900
	SWEX		X		550700	4077900

APPENDIX B

SCHEDULE OF REPTILE SAMPLING ON 25 PLOTS.

APPENDIX B

Schedule of reptile sampling on 25 plots in four habitat types (COL = *Coleogyne*; LA = *Larrea-Ambrosia*; LLG = *Larrea-Lycium-Grayia*; and LG = *Lycium-Grayia*) during 19 sampling sessions (Sess) using trapping, noosing, and belt-transect observation techniques at Yucca Mountain, Nevada. Sampling events occurred at the place and day marked with an "x".

Sess	Date	Trapping			Noosing																		Belt Transect Observations										
		COL	LA	LLG	COL		LA	LLG															LG				COL				LLG				LG			
		2t	3t	2t	2t	5t	3t	2t	4c	5t	5c	7t	8c	11t	bpit	ff2c	ff5c	ff6c	fran	mash	np1[a]	np2[b]	swex	7t	6t	3c	2t	3c	4c	5t	2t	5c	7t	8c	3c	4c	6t	7t
1	6/03/91		x	x			x	x																													
1	6/04/91		x	x			x	x																													
1	6/05/91		x	x			x	x																													
1	6/06/91		x	x			x	x																													
1	6/07/91		x	x			x	x																													
2	6/10/91			x			x	x																													
2	6/11/91		x	x																																	
2	6/12/91		x	x			x	x																													
2	6/13/91		x	x			x	x																													
2	6/14/91		x	x			x	x																													
3	8/26/91			x	x		x																													
3	8/27/91	x	x	x	x		x	x																													
3	8/28/91	x	x	x	x		x	x																													
3	8/29/91	x	x	x	x		x	x																													
4	9/03/91			x																																	
4	9/04/91	x	x	x			x																														
4	9/05/91	x	x	x			x																														
4	9/06/91	x	x	x			x																														
5	6/02/92	x	x	x	x		x	x																													
5	6/03/92	x	x	x	x		x	x																													
5	6/04/92	x	x	x	x		x	x																													
5	6/05/92	x	x	x	x		x	x																													

Schedule of reptile sampling on 25 plots in four habitat types at Yucca Mountain, Nevada.

Sess	Date	Trapping			Noosing																	Belt Transect Observations											
		COL	LA	LLG	COL		LA	LLG													LG				COL				LLG				LG			
		2t	3t	2t	2t	5t	3t	2t	4c	5t	5c	7t	8c	11t	bpit	ff2c	ff5c	ff6c	fran	mash	np1[a]	np2[b]	swex	7t	6t	3c	2t	3c	4c	5t	2t	5c	7t	8c	3c	4c	6t	7t
6	6/10/92																										x		x	x	x		x	x	x	x	x	
6	6/11/92																										x	x	x		x		x		x	x	x	x
6	6/12/92																										x	x	x	x	x		x	x			x	x
7	9/01/92	x	x	x	x		x	x																														
7	9/02/92	x	x	x	x		x	x																														
7	9/03/92	x	x	x	x		x	x																														
7	9/04/92	x	x	x	x		x	x																														
8	9/15/92					x					x	x												x	x													
8	9/16/92										x	x												x	x													
8	9/17/92					x					x	x												x	x	x												
8	9/18/92					x					x	x												x	x	x												
9	3/17/93								x				x	x			x						x	x	x						x	x			x			x
9	3/18/93							x		x										x	x																	
9	3/19/93								x				x	x			x						x															
9	3/20/93																																					
9	3/21/93																																					
9	3/22/93							x		x										x	x																	
9	3/23/93								x				x	x			x						x															
9	3/24/93							x		x										x	x																	
9	3/25/93			x					x				x	x			x						x															
9	3/26/93																																					
9	3/27/93																																					
9	3/28/93																																					
9	3/29/93								x				x	x			x						x															
9	3/30/93							x		x										x	x																	
10	5/03/93	x		x								•																										
10	5/04/93	x	x	x																																		
10	5/05/93	x	x	x																																		
10	5/06/93	x	x	x																																		
10	5/07/93	x	x	x																																		

Schedule of reptile sampling on 25 plots in four habitat types at Yucca Mountain, Nevada.

Sess	Date	Trapping						Noosing															Belt Transect Observations										
		COL	LA	LLG	COL	LA	LLG																COL				LLG				LG			
		2t	3t	2t	2t	5t	3t	2t	4c	5t	5c	7t	8c	11t	bpit	ff2c	ff5c	ff6c	fran	mash	np1[a]	np2[b]	swex	7t	6t	3c	2t	3c	4c	5t	2t	5c	7t	8c	3c	4c	6t	7t
11	5/17/93							x	x	x										x	x																
11	5/18/93												x	x					x				x														
11	5/19/93							x	x	x										x	x																
11	5/20/93												x	x					x				x														
11	5/21/93							x	x	x										x	x																
11	5/22/93																																				
11	5/23/93																																				
11	5/24/93												x	x					x				x														
11	5/25/93							x	x	x										x	x																
11	5/26/93												x	x					x				x														
11	5/27/93							x	x	x										x	x																
11	5/28/93												x	x					x				x														
12	10/12/93							x	x	x			x	x					x	x	x		x														
12	10/13/93							x	x	x			x	x						x	x		x														
12	10/14/93							x	x	x			x	x					x	x	x		x														
12	10/15/93																																				
12	10/16/93																																				
12	10/17/93																																				
12	10/18/93												x	x					x		x		x														
12	10/19/93							x	x	x										x																	
12	10/20/93							x	x	x			x	x					x	x	x		x														
12	10/21/93							x	x	x			x	x						x	x		x														
13	3/21/94							x	x				x	x									x														
13	3/22/94									x									x	x		x														
13	3/23/94							x	x				x	x									x														
13	3/24/94									x									x	x		x														
13	3/25/94																																				
13	3/26/94																																				
13	3/27/94																																				
13	3/28/94							x	x				x	x									x														
13	3/29/94									x									x	x		x														
13	3/30/94							x	x				x	x									x														
13	3/31/94									x									x	x		x														

Schedule of reptile sampling on 25 plots in four habitat types at Yucca Mountain, Nevada.

Sess	Date	Trapping			Noosing																	Belt Transect Observations											
		COL	LA	LLG	COL		LA	LLG														LG		COL				LLG				LG		
		2t	3t	2t	2t	5t	3t	2t	4c	5t	5c	7t	8c	11t	bpit	ff2c	ff5c	ff6c	fran	mash	np1[a]	np2[b]	swex	7t	6t	3c	2t	3c	4c	5t	2t	5c	7t	8c	3c	4c	6t	7t
14	5/02/94							x	x				x							x			x														
14	5/03/94									x					x				x			x															
14	5/04/94							x	x				x							x			x														
14	5/05/94									x					x				x			x															
14	5/06/94																																					
14	5/07/94																																					
14	5/08/94																																					
14	5/09/94							x					x						x	x																		
14	5/10/94								x	x					x							x	x															
14	5/11/94							x					x						x	x																		
14	5/12/94								x	x					x							x	x															
15	5/23/94	x	x	x																																		
15	5/24/94	x	x	x																																		
15	5/25/94	x	x	x																																		
15	5/26/94	x	x	x																																		

Schedule of reptile sampling on 25 plots in four habitat types at Yucca Mountain, Nevada.

Sess	Date	Trapping			Noosing																						Belt Transect Observations											
		COL	LA	LLG	COL		LA	LLG																LG			COL				LLG				LG			
		2t	3t	2t	2t	5t	3t	2t	4c	5t	5c	7t	8c	11t	bpit	ff2c	ff5c	ff6c	fran	mash	np1[a]	np2[b]	swex	7t	6t	3c	2t	3c	4c	5t	2t	5c	7t	8c	3c	4c	6t	7t
16	10/03/94							x		x			x										x															
16	10/04/94								x						x				x	x		x																
16	10/05/94																																					
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16	10/07/94																																					
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16	10/10/94							x		x			x										x															
16	10/11/94								x						x				x	x		x																
16	10/12/94									x			x										x															
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16	10/18/94							x		x			x										x															
16	10/19/94								x						x				x	x		x																
16	10/20/94								x						x				x	x		x																
16	10/21/94																																					
16	10/22/94																																					
16	10/23/94																																					
16	10/24/94							x																														

Schedule of reptile sampling on 25 plots in four habitat types at Yucca Mountain, Nevada.

Sess	Date	Trapping			Noosing																	Belt Transect Observations										
		COL	LA	LLG	COL		LA	LLG														LG	COL			LLG				LG			
		2t	3t	2t	2t	5t	3t	2t	4c	5t	5c	7t	8c	11t	bpit	ff2c	ff5c	ff6c	fran	mash	np1[a]	np2[b]	swex	7t	6t	3c	2t	3c	4c	5t	2t	5c	7t	8c	3c	4c	6t	7t
17	3/27/95									x			x									x																
17	3/28/95								x			x			x					x																			
17	3/29/95									x			x									x																
17	3/30/95								x			x			x					x																		
17	3/31/95																																					
17	4/01/95																																					
17	4/02/95																																					
17	4/03/95									x			x									x																
17	4/04/95								x			x			x					x																		
17	4/05/95									x			x									x																
17	4/06/95								x			x			x					x																		
18	5/01/95								x			x				x	x			x																		
18	5/02/95									x			x		x			x																				
18	5/03/95								x			x				x	x			x																		
18	5/04/95									x			x		x			x																				
18	5/05/95																																					
18	5/06/95																																					
18	5/07/95																																					
18	5/08/95								x			x				x	x			x																		
18	5/09/95									x			x		x			x																				
18	5/10/95								x			x				x	x			x																		
18	5/11/95									x			x		x			x																				
19	5/23/95	x	x	x																																		
19	5/24/95	x	x	x																																		
19	5/25/95	x	x	x																																		

[a] np1 = NPORT-1
[b] np2 = NPORT-2

APPENDIX C

ANNOTATED CHECKLIST OF REPTILES

APPENDIX C

Annotated checklist of reptile species recorded at, and in the vicinity of, Yucca Mountain, Nevada, from 1991 to 1995.

In the following checklist, all measurements were made using metric scales: distances were recorded in meters or kilometers; specimen lengths, both snout-vent lengths (SVL) and tail lengths (TL), were recorded in millimeters; and the mass of animals (WT) was recorded in grams. Sizes were given as SVL-TL-WT. An "x" in place of a measurement denotes a number that was not recorded.

Order Testudines, Family Testudinidae

***Gopherus agassizii*..... desert tortoise**

The desert tortoise at Yucca Mountain is at the extreme northern edge of its range, probably extending no more than 10 km north of the North Portal. They occur throughout the entire Yucca Mountain area, but are most common in *Larrea-Lycium-Grayia* habitats. Relative to other areas in their range, they are uncommon at Yucca Mountain (approximately 5.8 animals per km^2 in *Larrea-Lycium-Grayia*). Extensive research has been conducted on the desert tortoise at Yucca Mountain, and readers are directed to this literature (CRWMS M&O 1995, 1996*c*, 1996*d*, 1996*e*).

Order Squamata, Suborder Sauria, Family Crotaphytidae

***Crotaphytus insularis*..... desert collared lizard**

A total of 38 captures were made of 24 individuals on 8 of 22 plots in *Coleogyne, Larrea-Lycium-Grayia, and Lycium-Grayia* habitats. None were captured in *Larrea-Ambrosia* areas. One additional specimen was collected near the top of Exile Hill in *Larrea-Lycium-Grayia* habitat.

On plot LLG2T, a single young animal (45-80-2.8) was captured. It was observed on August 28, 1991, and September 4, 1991, and was never seen again. It was captured on the edge of the plot both times.

On plot LLG4C, a total of six animals were captured by hand or by noose between March 1993 and April 1995. Five of these lizards were captured once, and the sixth was captured four times over three years (March 23, 1993, March 28 and 30, 1994, and April 4, 1995). One female and five males were captured. The size of these lizards ranged from 58-117-7.8 to 95-208-33.2. The female, captured on May 27, 1993, was not gravid. The male captured over three years was adult size when first captured (95-173-24), but lost tail length and weight over the years (98-165-21.5). The first, third, and fourth times it was captured, it was captured in the same corner of the plot (maximum distance between points = 10.6 m). The second time it was captured, it was approximately 50 m from the other three points.

On plot FRAN, six animals were captured a total of eight times. The first was captured on May 26, 1993, and the remaining lizards were captured in May 1995. Five of the captures (three new animals) were on May 10, 1995, between 1220 and 1515 hours. Three males and three females were captured. On May 10, 1995, one of the females was gravid, and another pair appeared to be engaged in courtship behavior. The size of these five lizards ranged from 84-160-24.6 to 95-180-34.5. The two animals captured more than once were caught in May 1995 both times. All of the captures were in a portion of the plot with moderate-sized boulders (< 1 m diameter); none were caught in less rocky areas, and none were caught in an area with large boulders.

On five plots (COL5T, LG3C, LG6T, LG7T, LLG5C) that were only sampled in September 1992, a total of 19 captures were made of 11 *C. insularis*. These consisted of 4 males and 7 females, and based on their relatively small sizes (average 50-105-4.1), all were judged to be juvenile.

Gambelia wislizenii ..... **longnose leopard lizard**

A total of 33 *Gambelia wislizenii* were captured or collected in the four vegetation associations at Yucca Mountain. Twenty-nine animals were captured and released in *Larrea-Lycium-Grayia* (n = 5 animals, 3 plots), *Coleogyne* (n = 7, 1 plot), and *Larrea-Ambrosia* (n = 17, 1 plot) habitats. Four specimens were collected, three from near Yucca Mountain (*Larrea-Ambrosia* 2; *Larrea-Lycium-Grayia* 1), and 1 was collected at approximately 1,460 m elevation on Pahute Mesa Road, northeast of Yucca Mountain, probably in *Lycium-Grayia* habitat.

Most of these animals (n = 24) were captured only once; however, seven were captured twice, and one was captured four times. Of the eight that were captured more than once, six were recaptured during the same trapping session; the other two were captured 3 (June and September, 1991) and 21 months apart (September 1991 and May 1993). The animal captured 3 months apart changed little in size, but the other was initially captured as a juvenile (55-114-4.8) and more than doubled in length and increased more than 8 times in mass (111-221-39.5) over the duration.

Eleven males, 15 females, and 4 of undetermined gender were captured. Four gravid animals were captured between May 3 and June 3 (1 in 1992, 2 in 1993, 1 in 1995) in *Coleogyne*, *Larrea-Lycium-Grayia*, and *Larrea-Ambrosia* habitats. Thirteen juvenile lizards, judged by small size (SVL < 65 mm) and low mass (3 to 5.2 g), were captured in August 1991 and September 1992 on plots COL2C (n = 3) and LA3T (n = 10). Sizes of the animals judged to be adult ranged from 69-151-9 to 130-241-59.

Order Squamata, Suborder Sauria, Family Iguanidae

***Dipsosaurus dorsalis*.....desert iguana**

One *Dipsosaurus dorsalis* was recorded on the east side of Yucca Mountain. It was collected on June 2, 1992, in *Larrea-Ambrosia* habitat just east of Fran Ridge. No *D. dorsalis* were captured using any sampling technique. However, this species was frequently seen in Crater Flats on the west side of Yucca Mountain. One was reported from the road west of Fran Ridge on May 25, 1994 (J. Mueller, pers. comm.), and one was observed in Crater Flats on December 20, 1995, when air temperatures were approximately 4 to 7° C with wind speeds in excess of 25 km per hour (J. Boone, pers. obs.).

***Sauromalus obesus*..... chuckwalla**

Sauromalus obesus appeared to be common, but were generally restricted to rocky outcrops, a habitat under-sampled in this study. Reported observations were few (51), but that reflects a lack of records, not a lack of animals. These animals can be easily found, apparently in relatively high numbers, in rocky habitats (92% of records) on the crest of Yucca Mountain, Castle Point, Fran Ridge, and elsewhere. These animals were observed, not captured, therefore gender could not be determined and measurements could not be made. Reproduction appeared to be substantial as approximately half (54%) of the individuals recorded were juvenile. Although population sizes were not estimated, there was no indication of significant change in numbers during this study.

Order Squamata, Suborder Sauria, Family Phrynosomatidae

***Phrynosoma platyrhinos*.....desert horned lizard**

Ninety-seven observations were made on a total of 61 *Phrynosoma platyrhinos* in three vegetation associations. Twenty-two were captured in *Larrea-Lycium-Grayia* (3 plots), 20 in *Coleogyne*, and 17 in *Larrea-Ambrosia*. In addition, one each was collected from *Larrea-Lycium-Grayia* and *Larrea-Ambrosia* habitats.

The 59 animals that were released were captured a total of 95 times. Most (37) were captured once, 14 were captured twice, 4 were captured three times, 1 was captured four times, and 3 were captured five times. Of those that were recaptured at least twice, most were recaptured during the same trapping session, but six were captured over longer durations. Of these six, one was caught 1 month apart, three were caught 9 to 13 months apart, and two were recaptured 21 months apart. The animals captured more than 9 months apart were each caught 3 to 5 times.

The sex ratio of captured animals was slightly skewed towards males. Of 47 animals with recorded gender, 30 were male. None of the 17 females were recorded as gravid, but 14 were specifically recorded as not gravid. Mass was recorded on 70 occasions, and 37 lizards weighed 9.0 g or less. These animals, judged to be juveniles, were captured throughout the year (March to October), although the smallest lizards (WT < 3 g) only appeared in the fall (September and October). Lengths and weight ranged from 29-14-0.7 to 91-56-27.

Callisaurus draconoides ..... **zebratail lizard**

Three *Callisaurus draconoides* were recorded. One, probably an adult male (48-69-x), was captured in a funnel trap in May 1993 in *Coleogyne* habitat. It was never recaptured. The second, a dead male (91-105-x) was found on the road just north of plot COL3T in May 1992, and preserved in alcohol. A third was captured and collected on the northern flank of Little Skull Mountain near plot LLGFF5C in 1995.

Despite the lack of records from the Yucca Mountain area, this species was relatively common in lower-elevation, sandy and gravely washes, and it was probably the second or third most common species overall depending on the area (after *Uta* and sometimes *Cnemidophorus*). *Callisaurus draconoides* is a very wary and fast species that was difficult to catch using a noose, and apparently difficult to catch in funnel and pitfall traps. Zebratail lizards were observed most frequently in sand and gravel washes, and the lack of captures in funnel and pitfall traps may have been due to inadequate sampling in that habitat.

Sceloporus graciosus ..... **sagebrush lizard**

This species was reported from higher elevation *Pinyon-Juniper-Artemisia* habitats on the Nevada Test Site, but it was not recorded on Yucca Mountain. The lack of records probably reflects a true absence on Yucca Mountain (due to lack of appropriate habitat), but it may reflect insufficient sampling effort at higher elevations in the Yucca Mountain area.

Sceloporus magister ..... **desert spiny lizard**

Sceloporus magister appeared to be uncommon, but widely distributed throughout the area. A total of 25 records were made of 18 individuals that were captured in the three lower-elevation habitats. Based on captures, it appeared to be most numerous in *Larrea-Ambrosia* areas, as 11 were captured on the one plot in that habitat. Six were captured on four *Larrea-Lycium-Grayia* plots (LLG2T, LLGFF2C, LLGFF6C, and MASH), and one was captured in *Coleogyne* habitat on plot COL2T. However, it was not unusual to see this species basking on boulders along rocky outcrops on the crest of Yucca Mountain and on Castle Point.

Most of the animals were captured in funnel traps (n = 15) rather than other methods (pitfall = 5, noosing = 5). These lizards appeared to learn to avoid traps, as 12 were captured on a single occasion, five were captured twice, and only one was captured three times. Of those captured more than once, only one was captured during more than one trapping session, and this animal was captured 2 years apart (June 4, 1992, to May 25, 1994).

Of the 18 individuals captured, 7 were male, 9 were female, and 2 juveniles were listed as gender unknown. Six of the observations of females recorded that they were not gravid; the other five did not record this data. Juveniles (SVL < 40 mm) appeared in August and September of 1991 (n = 3) and 1992 (n = 1). Size distributions of captured animals were bimodal. Four juveniles were small (SVL = 32 to 38; TL = 43 to 45), and the remaining 15 were much larger (SVL = 79 to 104; TL = 53 to 142).

***Sceloporus occidentalis*..... western fence lizard**

A single specimen (preserved in alcohol) was collected in Fortymile Canyon, north of benchmark MAX on May 28, 1992. It was judged to be a male, and its measurements were 79-67-15g. No records of this species were made at Yucca Mountain, proper.

***Uta stansburiana*.....side-blotched lizard**

Uta stansburiana was the most common and widely distributed reptilian species in the Yucca Mountain area. It was found at all elevations and in all habitat types. A total of 5,497 records were made on 2,508 individuals, and of these, 1,253 were female and 1,160 were male (gender was not determined on the remaining 95 individuals)

Gravid females (n = 518) were captured in all months that were sampled, but the majority were captured in March (n = 119) and May (n = 354). In the other months, 26 were recorded in June and 19 were recorded in late September and October. Juveniles, animals with the smallest snout-vent lengths (16 to 25 mm, n = 32), were recorded in June (n = 9), August (n = 7), September (n = 15), and October (n = 1). A group of larger juveniles (snout-vent lengths of 26 to 30, n = 144) was caught only during August (n = 15), September (n = 102), and October (n = 27).

Order Squamata, Suborder Sauria, Family Gekkonidae

***Coleonyx variegatus*.....western banded gecko**

Fifty observations were made on 41 individual *Coleonyx variegatus*. Most of the animals were captured in 1991 (n = 28) and 1992 (n = 13). In 1993, 1994, and 1995, only one animal was captured per year.

This species was detected only using trapping techniques, but it was recorded in all three vegetation associations sampled with this method. The distribution of catches was relatively even across vegetation associations (*Coleogyne*, 16; *Larrea-Ambrosia* 12; *Larrea-Lycium-Grayia* 13), across trapping methods (pitfall, 22; funnel trap, 28), and across genders (female, 16; male, 18; unknown, 7).

Most animals were observed only once (n = 33) and rarely recaptured (7 were captured twice and 1 captured three times). The maximum time interval between recaptures was 364 days (June 5, 1991 to June 3, 1992), and two individuals were captured nine months apart (intervals of 272 and 273 days).

Juveniles, judged to be animals with snout-vent lengths less than 40 mm (n = 13) were only recorded between August 28 and September 5. Eleven of these were captured in 1991, and the remaining two were captured in 1992. None were observed after September 4, 1992. No females were recorded as gravid.

Order Squamata, Suborder Sauria, Family Xantusiidae

***Xantusia vigilis*..... desert night lizard**

No *Xantusia vigilis* were recorded at Yucca Mountain, probably because the appropriate habitat (*Yucca schidigera*) does not occur there.

Order Squamata, Suborder Sauria, Family Teiidae

***Cnemidophorus tigris*..... western whiptail**

Cnemidophorus tigris was the second most common lizard species in the Yucca Mountain area with the possible exception of *Callisaurus draconoides* at some locations. Records of 1,041 captures of 570 individuals were recorded on 19 plots and in all vegetation associations. Some of the animals caught multiple times were recaptured the same day. If only one observation per day were recorded, then only 999 records would exist.

Recapture rate was generally low. Of the 570 individuals captured, 349 were caught only once, 108 were caught twice, 55 were caught three times, and the remaining 58 individuals were caught 4 to 10 times. Time intervals between recaptures ranged from 1 to 719 days. There were 309 records of individuals captured at intervals ranging from 0 to 3 months, 40 at 8 to 9 months, 67 at 11 to 12 months, and 2, 5, and 2 at 16, 21, and 24 months, respectively.

Gravid females (n = 68) were recorded in May (n = 53), June (n = 15), and August (n = 1). Most of the records were from 1993 (n = 22) and 1994 (n = 27). The remaining records were 1991 (n = 8), 1992 (n = 7), and 1995 (n = 6). The appearance of juveniles, judged to be lizards with snout-vent lengths of less than 60 mm, differed among years: in 1991 and 1992, they were observed late in the year, whereas in 1993 and later years, they were observed early in the year. Juveniles were recorded in August (n = 59) and September (n = 20) of 1991. In 1992, they were only recorded in June (n = 1) and September (n = 48), but in 1993, 1994, and 1995, they were only recorded in May. The number of juveniles recorded declined over the duration of the study (1991, 79; 1992, 49; 1993, 14; 1994, 17, and 1995, 1). Records of smaller lizards (snout-vent lengths < 50 mm, n = 40) declined even more precipitously over the duration of the study: 1991, 28; 1992, 10; 1993, 0; 1994, 1; 1995, 1. Differences in trapping schedules and methods may have contributed to the pattern in the data.

Order Squamata, Suborder Sauria, Family Scincidae

***Eumeces gilberti*..... Gilbert's skink**

A single *Eumeces gilberti* was recorded at Yucca Mountain on May 24, 1995. The animal, an adult male (79-120-10.5), was captured and collected in *Larrea-Lycium-Grayia* habitat in a funnel trap on plot LLG2T. This record extends the distribution of this species, filling a gap between more northern locations on the Nevada Test Site (Pahute Mesa area) and locations off the Nevada Test Site to the south (Spring Mountains) and west (Grapevine Peak). The collection elevation of 1,130 m may be unusually low for this species in the desert.

Eumeces skiltonianus ..... **western skink**

This species has not been recorded on Yucca Mountain.

Order Squamata, Suborder Serpentes, Family Leptotyphlopidae

Leptotyphlops humilis ..... **western blind snake**

This species has not been recorded on Yucca Mountain.

Order Squamata, Suborder Serpentes, Family Colubridae

Arizona elegans ..... **glossy snake**

A single specimen from Yucca Mountain was collected and preserved, but specific collection data were not recorded. Two roadkills were reported to have been collected. One, collected on Lathrop Wells Road 2 mi south of the Field Operations Center on June 4, 1991, measured 750-115-103. The other, found dead on H Road 100 m east of K Road, and collected April 28, 1992.

Chionactis occipitalis ..... **western shovelnose snake**

Seven specimens were observed. Six individuals were captured in *Larrea-Ambrosia* habitat (plot LA3T), and one specimen, collected near H Road and 2nd Street, was preserved without measurement data. The six specimens were captured in June of 1991 ($n = 2$) and 1992 ($n = 4$) in pitfall ($n = 5$) and funnel ($n = 1$) traps. Three of these were female, two were male, and one was not determined. Sizes ranged from snout-vent lengths of 254 to 287 mm, tail lengths of 49 to 66 mm, and mass of 8 to 10 g.

Diadophis punctatus ..... **ringneck snake**

None were collected, therefore its presence at Yucca Mountain could not be documented; however, two snakes were seen that may have been this species. One was probably seen in *Lycium-Grayia* habitat near the crest of Yucca Mountain. Another may have been captured west of Tortoise Hill near plot LLG4C.

Hypsiglena torquata ..... **night snake**

Four *Hypsiglena torquata* were captured. Three were found in *Coleogyne* habitat on plot COL2T ($n = 3$), and one was from *Larrea-Lycium-Grayia* habitat on plot LLG2T ($n = 1$). One was captured and collected in May (1994), two were captured in June (1992), and one was captured in August (1991). All were captured in funnel traps.

Three of these snakes were female and one was of undetermined gender. Sizes ranged from snout-vent lengths of 225 to 355 mm, tail lengths of 36 to 66 mm, and masses of 4.8 to 15 g.

Lampropeltis getula ..... **common kingsnake**

There were nine records of *Lampropeltis getula* in the Yucca Mountain area. Six were captured on the reptile study plots in *Larrea-Lycium-Grayia* ($n = 5$) and *Larrea-Ambrosia* ($n = 1$) habitats. Two additional records were made in *Larrea-Ambrosia* areas: H-Road in Jackass Flats, the Environmental Sciences Department trailers in area 25 Base Camp, and one was observed in lower Fortymile Wash near the Lathrop Wells Gate (J. Boone, personal observation).

Of the six animals from the reptile trapping grids, two were captured in funnel traps (LLG2T and LA3T) and the remainder were hand-captured (Borrow Pit, LLGFF2C, FRAN, and LLG5T). No more than one was captured per plot. Genders were determined on five specimens (1 female, 4 males). Sizes ranged from snout-vent lengths of 320 to 965 mm, tail lengths of 41 to 150 mm, and masses of 10.5 to 245 g.

Masticophis flagellum ..... **coachwhip**

Fifty-four observations were recorded for 47 *Masticophis flagellum* individuals: 45 individuals were captured during trapping studies, and two specimens were collected. Animals were captured in all vegetation associations, but most ($n = 32$) were captured in *Larrea-Lycium-Grayia* habitat. The frequency of capture may reflect sampling effort, as six and seven were captured in *Larrea-Ambrosia* and *Coleogyne*, respectively, and one was recorded from *Lycium-Grayia*. Most animals were observed only once ($n = 39$). Only five animals were captured twice, and one was captured three times. Of those recaptured, one was recaptured after 4 months and another was recaptured after 21 months. Animals were captured most often in funnel traps ($n = 33$) rather than in pitfall traps ($n = 1$; pits were likely too shallow), or by hand ($n = 18$).

Five males, 12 females, and 5 of undetermined gender were recorded. The frequency of gender records was significantly biased towards females ($\chi^2 = 5.8$, $P < 0.025$). Gravid females ($n = 2$) were recorded in May of 1993 and 1994. Juvenile snakes, judged as animals with snout-vent lengths of 500 mm or less were captured throughout the year, and the distribution throughout the years was relatively even (1992, $n = 2$; 1993, $n = 1$; 1994, $n = 3$; 1994, $n = 1$). The smallest animal (76-26-x) was captured in mid-October.

Masticophis taeniatus ..... **striped whipsnake**

A small *Masticophis taeniatus* of undetermined gender was captured and collected in September 1992 in high-elevation *Coleogyne* habitat (plot COL5T) on the crest of Yucca Mountain. Its measurements were 47.6-18.5-19.5, and it was preserved as a freeze-dried specimen. The following day, another snake, believed to be an adult *Masticophis taeniatus*, was observed on that plot. A third observation, almost certainly of this species, was made in the high-elevation *Coleogyne* habitat near the top of Castle Point near COL6C in July, 1996 (J. Boone, pers. obs.). The animal could be seen clearly, but not captured, under a boulder.

***Phyllorhynchus decurtatus*.....spotted leafnose snake**

A single *Phyllorhynchus decurtatus* was observed at Yucca Mountain. This animal was captured and photographed on study plot LA3T on June 11, 1991. No data were recorded, but from the photographs, the specimen appears to be an adult. One additional specimen was collected from the Mercury Highway near US Highway 95.

***Pituophis melanoleucus*.....gopher snake**

Sixteen records of 13 individual *Pituophis melanoleucus* were recorded at Yucca Mountain. Twelve animals were recorded on the reptile study plots (one was collected), and one was collected on top of Yucca Mountain. An additional specimen (road-kill) was collected on Jackass Flats Road 1.6 km west of Mercury. These specimens were recorded in all habitat types, but the majority (n = 8) were observed in *Larrea-Lycium-Grayia* areas, possibly reflecting sampling effort. A single observation was recorded in *Larrea-Ambrosia* areas, but this probably reflects a lack of observation records rather than rarity in this vegetation association, as many were observed crossing H-Road and the Lathrop Wells Road in Jackass Flats. Nine animals were captured only once, and three were captured twice. Of those three, two were captured on consecutive days, but the third was captured in March of 1993 and 1994. Snakes were captured in funnel traps (n = 8) and by hand (n = 7), but not in pitfall traps.

Genders of captured animals were skewed towards females. Seven females, one male, and 4 of undetermined gender were captured. One gravid animal was captured in May 1995. Small snakes (SVL < 500 mm) were observed in May (1993, 1), and September (1992, 1).

***Rhinocheilus lecontei*.....longnose snake**

Twenty-eight observations were made of 22 individuals in the Yucca Mountain area. Two additional specimens were collected at the intersection of the Lathrop Wells and Jackass Flats Road, and one was collected 8 km east of the intersection. Of those at Yucca Mountain, animals were recorded in the three lower-elevation habitats (*Coleogyne*, 3; *Larrea-Lycium-Grayia*, 13; *Larrea-Ambrosia*, 6). Most of the captures were in funnel traps (n = 25). Only three animals were captured in pitfall traps (n = 2) or by hand (n = 1). Few were recaptured, as 17 were captured on a single occasion, 4 were captured twice, and a single animal was captured three times. All recaptures occurred during the same trapping session and on consecutive days.

The sex ratio was skewed towards males: 14 males, 7 females, and 1 of undetermined gender were recorded. None of the females captured were recorded to have been gravid, but five were recorded as not gravid. The four smallest animals (SVL < 300 mm) were captured in June (n = 1) and September (n = 3) of 1991 (n = 1) and 1992 (n = 3). Two slightly longer snakes (SVL approximately 345) were recorded in 1993. No snakes with snout-vent lengths less than 500 mm were captured after May 1993.

Salvadora hexalepis ..... **western patchnose snake**

Twelve observations were recorded of 12 individuals. Eight animals were captured on reptile sampling plots and four road-kills were collected and preserved (freeze-dry = 1, alcohol = 3). Eleven of these were captured or collected at Yucca Mountain, and the 12th specimen was collected on 2nd Street, 2 km south of H-Road in Area 25 Base Camp. All animals were collected at lower elevations, with seven from *Larrea-Lycium-Grayia*, four from *Larrea-Ambrosia*, and one from *Coleogyne*. The eight trapped snakes were captured in funnel traps (n = 6) or by hand (n = 2); none were captured in pitfall traps. No snake was recaptured.

Sex ratio was four females, two males, and two of undetermined gender. None of the females captured were recorded to have been gravid, but three were recorded as not gravid. No juveniles were captured; the smallest animal was longer than 500 mm.

Sonora semiannulata ..... **ground snake**

Twenty-nine individuals were captured or collected at Yucca Mountain; a 30th specimen was collected, but its location was not recorded. On the reptile sampling plots, 28 observations were recorded of 27 individuals. Two additional specimens were collected and freeze-dried. All of the animals captured on the study plots were collected at lower elevations (*Larrea-Lycium-Grayia*, n = 18; *Larrea-Ambrosia*, n = 3, and *Coleogyne*, n = 7). Most of the animals were captured in funnel (n = 17) or pitfall traps (n = 8), and three were captured by hand. Only one snake was recaptured, and this was on consecutive days.

Sex ratio from the sampling plots was 12 each of females and males, and three of undetermined gender. None of the females captured were recorded to have been gravid, but three were recorded as not gravid. One small snake (SVL = 128 mm) was captured March 28, 1994. Snout-vent lengths for the remaining animals ranged from 180 to 360 mm, tail length ranged from 63 to 85 mm, and mass ranged from 6.5 to 12.5 g.

Tantilla hobartsmithi ..... **southwestern blackhead snake**

Six observations of six individuals were recorded on the reptile sampling plots. One of the six was collected on plot COL2T and freeze-dried. All of the animals were observed at lower elevations, with four from *Larrea-Lycium-Grayia* and two from *Coleogyne*. All animals were captured in pitfall traps and none were recaptured.

Sex ratio of examined specimens was two females and three males. One of the females, captured June 6, 1991, was recorded to have been gravid. No small snakes were captured. Snout-vent lengths for the five animals ranged from 186 to 217 mm, tail length ranged from 48 to 72 mm, and mass ranged from 1.5 to 3.2 g.

Trimorphodon biscutatus ..... **lyre snake**

This species has not been recorded on Yucca Mountain.

Order Squamata, Suborder Serpentes, Family Viperidae

***Crotalus cerastes*.....sidewinder**

One animal was recorded on the reptile sampling plots, and three additional specimens were collected and preserved (freeze-dried = 1, alcohol = 2). One of the collected specimens did not have collection location information, but the other three animals were collected at lower elevations, with one from *Larrea-Lycium-Grayia* and two from *Larrea-Ambrosia*. The two from *Larrea-Ambrosia* were road-kills collected near the Canyon Substation on H-Road in Jackass Flats. Observations recorded during opportunistic sampling, as well as unrecorded observations, suggest that sidewinders are not uncommon in the sandy *Larrea-Ambrosia* habitat.

Gender was recorded on two females. One of the road-killed females, found on May 2, 1994, was gravid and contained 13 embryo with sizes that averaged 6 by 14 mm. No small snakes were recorded. Snout-vent lengths for two animals were 441 and 552 mm, and tail lengths were 35 and 36 mm.

***Crotalus mitchellii*.....speckled rattlesnake**

No *Crotalus mitchellii* were recorded on the reptile sampling plots, but three specimens were collected and preserved (2 freeze-dried; 1 in alcohol). One of the specimens was collected on Jackass Flats road between Yucca Mountain and Mercury, and the other two were collected in *Larrea-Lycium-Grayia* habitat. Other observations of speckled rattlesnakes near Yucca Mountain occurred in *Coleogyne* habitat in Midway Valley and in *Larrea-Lycium-Grayia* habitat on Fran Ridge and Exile Hill. One observation, made in association with desert tortoise range studies, occurred approximately 5 km south of Control Point which is situated on the ridge separating Yucca and Frenchman Flats. Genders were recorded as two males and one female. The size of one specimen was 605-66-x.

APPENDIX D

NUMBER OF REPTILES CAPTURED USING PITFALL AND FUNNEL TRAPPING TECHNIQUES ON 3 PLOTS DURING 19 TRAPPING SESSIONS.

APPENDIX D

Number of reptiles captured using pitfall and funnel trapping techniques on 3 plots during 19 trapping sessions (June 1991 to May 1995) at Yucca Mountain, Nevada. Sampling session dates defined in Appendix 2.

Plot	Species	Common Name	Sampling Session																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
LA3T																					
	Gambelia wislizenii	longnose leopard lizard	0	0	1	0	2		3			1					0				0
	Phrynosoma platyrhinos	desert horned lizard	0	0	0	0	1		1			0					1				2
	Sceloporus magister	desert spiny lizard	1	1	2	2	2		1			0					2				2
	Uta stansburiana	side-blotched lizard	4	5	3	4	16		22			42					23				7
	Coleonyx variegatus	western banded gecko	2	2	1	3	3		3			0					0				0
	Cnemidophorus tigris	western whiptail	7	12	13	11	33		21			27					22				3
	Chionactis occipitalis	western shovelnose snake	1	1	0	0	4		0			0					0				0
	Lampropeltis getula	common kingsnake	0	0	0	0	0		1			0					0				0
	Masticophis flagellum	coachwhip	0	0	0	0	0		1			1					1				2
	Pituophis melanoleucus	gopher snake	0	0	0	0	0		0			1					0				0
	Rhinocheilus lecontei	longnose snake	0	0	0	0	1		1			3					1				0
	Salvadora hexalepis	western patchnose snake	0	1	0	0	1		0			0					0				1
	Sonora semiannulata	ground snake	0	0	0	0	2		0			0					1				0
	Crotalus mitchellii	speckled rattlesnake	0	0	0	0	0		0			1					0				0
COL2T																					
	Callisaurus draconoides	zebratail lizard			0	0	0		0			1					0				0
	Gambelia wislizenii	longnose leopard lizard			0	0	0		2			1					0				0
	Phrynosoma platyrhinos	desert horned lizard			1	0	6		1			3					1				0
	Sceloporus magister	desert spiny lizard			0	0	0		0			1					0				0
	Uta stansburiana	side-blotched lizard			21	18	21		20			58					20				16
	Coleonyx variegatus	western banded gecko			4	9	1		2			1					0				1
	Cnemidophorus tigris	western whiptail			23	11	55		17			43					24				5
	Hypsiglena torquata	night snake			1	0	2		0			0					0				0
	Masticophis flagellum	coachwhip			0	0	1		1			0					5				0
	Pituophis melanoleucus	gopher snake			0	0	1		1			0					0				1
	Rhinocheilus lecontei	longnose snake			1	0	0		1			0					0				1
	Salvadora hexalepis	western patchnose snake			0	0	1		0			0					0				0
	Sonora semiannulata	ground snake			1	0	5		0			1					0				0
	Tantilla hobartsmithi	southwestern blackhead snake			0	0	0		0			1					0				0

Number of reptiles captured using pitfall and funnel trapping techniques.

Plot	Species	Common Name	Sampling Session																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
LLG2T																					
	Sceloporus magister	desert spiny lizard	1	0	0	0	0		0			0					0				0
	Uta stansburiana	side-blotched lizard	6	5	18	20	33		23		2	31					1				0
	Coleonyx variegatus	western banded gecko	1	2	2	3	4		1			0					1				0
	Cnemidophorus tigris	western whiptail	20	21	19	26	47		17			19					10				0
	Eumeces gilberti	Gilbert's skink	0	0	0	0	0		0			0					0				1
	Hypsiglena torquata	night snake	0	0	0	0	0		0			0					1				0
	Lampropeltis getula	common kingsnake	0	0	0	0	0		0			0					1				0
	Masticophis flagellum	coachwhip	0	0	0	0	5		1			5					5				2
	Pituophis melanoleucus	gopher snake	1	0	0	0	1		0			0					0				0
	Rhinocheilus lecontei	longnose snake	0	2	0	2	2		1			4					0				1
	Salvadora hexalepis	western patchnose snake	0	0	0	0	0		0			2					0				0
	Sonora semiannulata	ground snake	6	3	1	0	3		0			0					1				0
	Tantilla hobartsmithi	southwestern blackhead snake	3	1	0	0	0		0			0					0				0
	Crotalus mitchellii	speckled rattlesnake	0	0	0	0	0		0			1					1				0

APPENDIX E

NUMBER OF REPTILES CAPTURED USING NOOSING TECHNIQUES ON 22 PLOTS DURING 19 TRAPPING SESSIONS

APPENDIX E

Number of reptiles captured using noosing techniques on 22 plots during 19 trapping sessions (June 1991 to May 1995) at Yucca Mountain, Nevada. Sampling session dates and habitat codes are defined in Appendix 2.

Plot	Species	Common Name	Sampling Session 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
BPIT (LLG)																					
	Gambelia wislizenii	longnose leopard lizard									0		0	0	1	1		0	0	0	
	Phrynosoma platyrhinos	desert horned lizard									1		2	2	4	4		3	1	2	
	Uta stansburiana	side-blotched lizard									69		60	47	38	23		25	14	18	
	Cnemidophorus tigris	western whiptail									0		5	0	0	7		0	0	9	
	Lampropeltis getula	common kingsnake									0		1	0	0	0		0	0	0	
	Sonora semiannulata	ground snake									0		0	0	1	0		0	0	1	
FRAN (LLG)																					
	Crotaphytus insularis	desert collared lizard									0		1	0	0	0		0	0	5	
	Gambelia wislizenii	longnose leopard lizard									0		0	0	0	0		0	0	1	
	Sauromalus obesus	western chuckwalla									0		0	0	0	0		0	0	1	
	Phrynosoma platyrhinos	desert horned lizard									0		0	0	1	2		1	1	0	
	Uta stansburiana	side-blotched lizard									100		81	68	41	31		26	20	18	
	Cnemidophorus tigris	western whiptail									0		2	0	1	8		0	0	3	
	Lampropeltis getula	common kingsnake									0		0	1	0	0		0	0	0	
	Masticophis flagellum	coachwhip									1		0	1	0	1		0	0	0	
	Pituophis melanoleucus	gopher snake									0		1	0	0	0		0	0	0	
	Crotalus cerastes	sidewinder									0		0	0	0	0		1	0	0	
	Gopherus agassizii	desert tortoise									0		1	0	0	0		0	0	0	
LLGFF2C																					
	Sceloporus magister	desert spiny lizard																		2	
	Uta stansburiana	side-blotched lizard																		37	
	Cnemidophorus tigris	western whiptail																		4	
	Lampropeltis getula	common kingsnake																		1	
	Pituophis melanoleucus	gopher snake																		1	
LLGFF5C																					
	Uta stansburiana	side-blotched lizard																		9	
	Cnemidophorus tigris	western whiptail																		3	
	Gopherus agassizii	desert tortoise																		1	

Number of reptiles captured using noosing techniques.

Plot	Species	Common Name	Sampling Session																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
LLGFF6C																					
	Sceloporus magister	desert spiny lizard																		1	
	Uta stansburiana	side-blotched lizard																		2	
	Cnemidophorus tigris	western whiptail																		7	
	Gopherus agassizii	desert tortoise																		1	
LLG2T																					
	Crotaphytus insularis	desert collared lizard	0	0	1	1	0		0		0		0	0	0	0		0		0	
	Gambelia wislizenii	longnose leopard lizard	0	1	0	0	0		0		0		0	0	0	0		0		0	
	Uta stansburiana	side-blotched lizard	27	17	62	30	87		80		85		42	44	30	14		7		0	
	Cnemidophorus tigris	western whiptail	11	3	3	2	9		1		0		5	0	0	5		0		1	
	Masticophis flagellum	coachwhip	1	0	1	0	1		0		0		0	0	0	0		0		0	
LLG4C																					
	Crotaphytus insularis	desert collared lizard									1		3	1	1	1		0	1	0	
	Uta stansburiana	side-blotched lizard									70		56	55	25	10		17	12	5	
	Cnemidophorus tigris	western whiptail									0		2	0	0	9		0	0	1	
	Masticophis flagellum	coachwhip									0		0	0	0	1		0	0	0	
	Rhinocheilus lecontei	longnose snake									0		0	0	0	1		0	0	0	
	Gopherus agassizii	desert tortoise									1		1	0	0	0		0	0	0	
LLG5C																					
	Crotaphytus insularis	desert collared lizard								1											
	Uta stansburiana	side-blotched lizard								55											
	Cnemidophorus tigris	western whiptail								1											
LLG5T																					
	Uta stansburiana	side-blotched lizard									57		53	37	18	14		7	9	2	
	Cnemidophorus tigris	western whiptail									0		8	0	2	12		0	0	8	
	Lampropeltis getula	common kingsnake									0		1	0	0	0		0	0	0	
	Masticophis flagellum	coachwhip									0		0	0	0	1		1	0	1	
	Pituophis melanoleucus	gopher snake									1		0	0	1	0		0	0	1	
	Crotalus mitchellii	speckled rattlesnake									0		1	0	0	0		0	0	0	
LLG7T																					
	Uta stansburiana	side-blotched lizard								38											
	Cnemidophorus tigris	western whiptail								1											

Number of reptiles captured using noosing techniques.

Plot	Species	Common Name	Sampling Session																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
LLG8C																					
	Uta stansburiana	side-blotched lizard									105		45	45	30	23		10	8	4	
	Cnemidophorus tigris	western whiptail									0		2	0	0	7		0	0	2	
	Masticophis flagellum	coachwhip									0		0	0	0	1		0	0	0	
	Pituophis melanoleucus	gopher snake									0		1	0	0	0		0	0	1	
	Salvadora hexalepis	western patchnose snake									0		1	0	0	1		0	0	0	
LLG11T																					
	Uta stansburiana	side-blotched lizard																	9	5	
	Cnemidophorus tigris	western whiptail																	0	1	
MASH (LLG)																					
	Gambelia wislizenii	longnose leopard lizard									0		2	0	0	0		0			
	Sceloporus magister	desert spiny lizard									0		2	0	0	0		0			
	Uta stansburiana	side-blotched lizard									41		60	35	17	14		9			
	Cnemidophorus tigris	western whiptail									0		8	0	0	11		0			
	Masticophis flagellum	coachwhip									2		0	0	0	0		0			
	Sonora semiannulata	ground snake									0		0	0	1	0		0			
NPORT-1 (LLG)																					
	Phrynosoma platyrhinos	desert horned lizard									1		1	0							
	Uta stansburiana	side-blotched lizard									48		19	19							
	Cnemidophorus tigris	western whiptail									0		11	0							
NPORT-2 (LLG)																					
	Uta stansburiana	side-blotched lizard													34	29		22	8		
	Cnemidophorus tigris	western whiptail													0	17		0	0		
	Masticophis flagellum	coachwhip													0	0		1	0		
SWEX (LLG)																					
	Uta stansburiana	side-blotched lizard									36		33	32	18	19		17			
	Cnemidophorus tigris	western whiptail									0		5	0	0	12		0			
	Gopherus agassizii	desert tortoise									0		0	0	0	0		1			
COL2T																					
	Gambelia wislizenii	longnose leopard lizard			2	1	0		2												
	Phrynosoma platyrhinos	desert horned lizard			4	4	6		5												
	Uta stansburiana	side-blotched lizard			44	35	59		47												
	Cnemidophorus tigris	western whiptail			8	5	16		1												
	Masticophis flagellum	coachwhip			0	0	1		0												

Number of reptiles captured using noosing techniques.

Plot	Species	Common Name	Sampling Session																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
COL5T																					
	Crotaphytus insularis	desert collared lizard								1											
	Uta stansburiana	side-blotched lizard								78											
	Masticophis taeniatus	striped whipsnake								1											
LA3T																					
	Gambelia wislizenii	longnose leopard lizard	1	2	4	4	2		2												
	Phrynosoma platyrhinos	desert horned lizard	0	0	1	5	1		8												
	Uta stansburiana	side-blotched lizard	3	3	8	4	3		13												
	Cnemidophorus tigris	western whiptail	6	5	10	5	27		3												
LG3C																					
	Crotaphytus insularis	desert collared lizard								5											
	Uta stansburiana	side-blotched lizard								35											
	Masticophis flagellum	coachwhip								1											
LG6T																					
	Crotaphytus insularis	desert collared lizard								2											
	Uta stansburiana	side-blotched lizard								71											
	Cnemidophorus tigris	western whiptail								1											
LG7T																					
	Crotaphytus insularis	desert collared lizard								2											
	Uta stansburiana	side-blotched lizard								60											

APPENDIX F

CONTENTS OF YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT REPTILE COLLECTION

APPENDIX F

Contents of Yucca Mountain Site Characterization Project reptile collection. Specimens were collected on or near Yucca Mountain or on the Nevada Test Site, Nye County, Nevada, at the specific location given. Column headings are defined as follows: ID = specimen number; Type = preservation type (FD = freeze dried, alc = alcohol, frz = in freezer), sex (M = male; F = female), age (A = adult; J= juvenile), size = Snout-vent and tail lengths (mm), and Mass (g).

Species	ID	Type	Sex	Age	Collector	Date	Size	Mass	Location	Comments
Order Testudines: Turtles										
Family Testudinidae: Tortoises										
Gopherus agassizii	R-22	FD	F	A	EG&G Staff				Yucca Mountain	
Gopherus agassizii	R-23	FD	F	A	Sowell, Holt	8/03/92			ESP LLG8C	Carcass#36, Tortoise#402
Gopherus agassizii	R-24	FD	U	J	Rautenstrauch	8/11/92			Tortoise Hill, 300 m W Dune Wash	hatchling, carcass#37, tort#112
Gopherus agassizii	R-25	FD	U	J	EG&G Staff				Yucca Mountain	hatchling
Order Squamata: Lizards and Snakes										
Suborder Sauria: Lizards										
Family Crotaphytidae										
Crotaphytus insularis	R-14	FD	M		Jim Mueller	4/21/92		36.5	40m E of N Exile Flag	rocky E-facing slope, 1230 hrs
Gambelia wislizenii	R-18	FD	F		Jim Mueller	5/20/92			E Edge of Exile Hill	full breeding colors, LLG assn
Gambelia wislizenii	R-19	FD	M		Jim Mueller	4/28/92			ESF Portal Road, 0.3 mi N H Road	dead on road
Gambelia wislizenii	JMM106	alc	F		T. Trustti	6/09/92	110-209	46g	Pahute Mesa Rd, at Rd 16-02	dead on road
Gambelia wislizenii	JMM111	alc			Jim Mueller	6/04/92			H-Road	dead on road
Family Iguanidae: Iguanids										
Dipsosaurus dorsalis	R-15	FD	M		Jim Mueller	6/02/92		84	200m S H-Rd on Rd to top of YM	
Sauromalus obesus	R-20	FD	M	A	EG&G Staff	6/10/92			YM, 100m S drill pad USW H-5	collected at 0920 hrs
Sauromalus obesus	R-21	FD	F	J	Greg Sharp	6/08/92			W of Tortoise Hill near LLG5C	
Family Phrynosomatidae:										
Callisaurus draconoides	JMM099	alc	M		Mike Cox	5/11/92	91-105		Midway Valley Rd, N COL3T	dead on road
Callisaurus draconoides	none	frz			Greg Sharp	1995			Little Skull Mt., near LLGFF5C	collected
Phrynosoma platyrhinos	R-16	FD	M		Mike Cox	6/04/92		25.5	100m E H-Rd at tip of Roy Ridge	large specimen
Phrynosoma platyrhinos	R-17	FD	M		Jim Mueller	6/03/92		16	500m E FOC on Lathrop Wells Rd	found alive on road
Sceloporus magister	R-12	FD	M		Green, Sowell	6/17/92			LA6T	
Sceloporus magister	R-13	FD	F		SAF	6/25/92			Mercury	
Sceloporus occidentalis	JMM110	alc	M		Allen, Sharp	5/28/92	79-67	15g	40-mile Canyon, N of bm MAX	collected

Contents of Yucca Mountain Site Characterization Project reptile collection.

Species	ID	Type	Sex	Age	Collector	Date	Size	Mass	Location	Comments
Uta stansburiana	JMM108	alc	M		Mike Cox	3/10/92	45-76	3.5g	near Muck Pile Hill (west of)	breeding colors, collected
Uta stansburiana	JMM113	alc	M		Mike Cox	3/11/92	51-86	4.6g	Area 25, Subdock	collected
Family Gekkonidae: Geckos										
Coleonyx variegatus	none	frz								
Coleonyx variegatus	none	frz	M		Sowell, Ambos	5/25/95	67-42	4	COL2T, funnel trap #23	captured 1000 - 1430 hrs.
Family Teiidae: Whiptails										
Cnemidophorus tigris	R-28	FD			EG&G Staff	5/05/94		8		
Cnemidophorus tigris	JMM101	alc	M		Aaron Ambos	6/01/92	85-177		Area 25, ESD Trailers	dead in trap, note double tail
Cnemidophorus tigris	JMM102	alc	M		EG&G Staff	6/03/92	85-177		LA3T	dead in trap, toe clip # 130
Cnemidophorus tigris	JMM103	alc	M		EG&G Staff	6/03/92	85-126+		LA3T	dead in trap, toe clip # 31
Cnemidophorus tigris	JMM104	alc	F		EG&G Staff	6/03/92	72-176+		COL2T	dead in trap, unmarked
Family Scincidae: Skinks										
Eumeces gilberti	none	frz	M	A	Sowell, Ambos	5/24/95	79-120	10.5	LLG2T, funnel trap #1	collected
Suborder Serpentes: Snakes										
Family Leptotyphlopidae: Slender Blind Snakes										
Family Colubridae: Colubrids										
Arizona elegans	R-7	FD	F		Jim Mueller				Yucca Mountain, Area 25	
Chionactis occipitalis	R-2	FD	F		Jim Mueller	1991			Near H Road and 2nd Street	
Hypsiglena torquata	R-29	FD			EG&G Staff	5/25/94	225-36	4.8	LLG2T, trap F31 (grid = 14,90)	collected
Lampropeltis getula	JMM094	alc	F		Andy Gabbert	10/15/92	889-114		FOC at ESD trailers	dead on road
Lampropeltis getula	JMM105	alc	M		Tim Lindeman	6/10/92	908-137	209g	Jackass Flats Rd, 10 mi W Mercury	dead on road
Lampropeltis getula	R-6	FD	F		EG&G Staff				Yucca Mountain	
Masticophis flagellum	R-8	FD	F		Jim Mueller	4/28/92			Midway Valley Rd, 3 mi N H Road	
Masticophis flagellum	JMM114	alc	M		Mike Cox	5/05/92	930-305	195g	2nd St, 1.5 mi N FOC	dead on road
Masticophis taeniatus	R-9	FD	F		Medrano, Sharp	9/17/92	47.6-18.5	19.5	COL5T	collected
Phyllorhynchus decurtatus	none	frz			Jim Mueller				NTS boundary S. of Gate 100	dead on road
Pituophis melanoleucus	JMM092	alc	M	A	Jim Mueller	5/14/92	1304-203		100 m N LG3C on top of YM	26C, windy, collected 1745 hr
Pituophis melanoleucus	JMM093	alc	F	A	Mike Cox	5/12/92	1145-186	323g	Jackass Flats Rd, 1 mi W Mercury	dead on road
Pituophis melanoleucus	JMM100	alc	F		Mike Cox	6/02/92	1184-185	450	LLG2T	dead in funnel-trap, from heat?
Pituophis melanoleucus	none	frz								
Rhinocheilus lecontei	R-3	FD	F		Sowell,	5/04/92			on road 0.5mi S Gate 500	road kill
Rhinocheilus lecontei	JMM097	alc	M		Jim Mueller	5/18/92	642-85+		Jackass Flats Rd, 4.8 mi E A25 cutoff	dead on road, 0730 hr
Rhinocheilus lecontei	JMM098	alc	M		Jim Mueller	5/12/92	645-111		Jackass Flats Road, Gate 500	collected, 0815 hr

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Species	ID	Type	Sex	Age	Collector	Date	Size	Mass	Location	Comments
Salvadora hexalepis	R-11	FD	M		EG&G Staff				Yucca Mountain	
Salvadora hexalepis	JMM096	alc	M		Andy Gabbert	5/01/92	713-65+		H-Road, at Canyon Substation	dead on road, tail broken
Salvadora hexalepis	JMM109	alc	M		Mike Cox	4/03/92			Midway Valley Road, SW Alice Hill	dead on road
Salvadora hexalepis	JMM112	alc	F		Jim Mueller	8/14/92	658-192	53.6g	2nd Street, 1.4 mi S H-Road	dead on road
Sonora semiannulata	R-1	FD	M		Andy Gabbert	5/19/92			East slope of Boundary Ridge	no orange spots
Sonora semiannulata	R-27	FD			EG&G Staff					
Tantilla hobartsmithi	R-26	FD			Allen, Campbell	5/03/93		1.6	COL2T	dead in pitfall
Family Viperidae: Pit Vipers										
Crotalus cerastes	R-5	FD	F	A	Jim Mueller	6/04/91			dirt road 0.3 mi N Well J-11	collected
Crotalus cerastes	JMM095	alc		A	D Rakestraw	4/27/92	441-35		H-Rd, 0.25 mi W Canyon Substation	DOR, 4 rattles + button
Crotalus cerastes	JMM115	alc	F		Jim Mueller	5/02/94	522-36	152g	H-Rd, 0.1 mi E 40-mile Cnyn Substn	Roadkill, 13 emb, Ave 14 x 6
Crotalus mitchellii	R-4	FD	M		Matt Walo	8/03/92			Exile trench T5-A (the long trench)	found in trench
Crotalus mitchellii	R-10	FD	F		EG&G Staff				Yucca Mountain	uncoiled specimen
Crotalus mitchellii	JMM107	alc	M		Mike Cox	6/26/92	605-66		Jackass Flats Road, E of Area 27	dead on road