EFFECTS OF PRESCRIBED FIRE ON A SNAKE PREDATOR AND ITS LIZARD PREY

FINAL REPORT

Matt Goode[1], Suzy Ehret[1], George Middendorf[2], Stevland Charles[2], Christopher Agard[2]
[1]School of Natural Resources, University of Arizona
[2]Howard University

Western National Parks Association
Chiricahua National Monument

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INTRODUCTION

The Banded Rock Rattlesnake (*Crotalus lepidus*, hereafter CRLE) is a small, secretive species inhabiting isolated montane areas in southeastern Arizona (Lowe et al., 1986), southwestern New Mexico (Degenhart et al., 1996) and northern Mexico (Armstrong & Murphy, 1979). Although CRLE are considered rare in Arizona, a dense population occurs at Chiricahua National Monument (CHIR) in the Chiricahua Mountains (Prival & Schwalbe, 2000) of southeastern Arizona. CRLE is a species of special concern at CHIR, largely because they are collected for the illegal pet trade (Prival & Schwalbe, 2000; S. Mazur, CHIR Ranger, personal communication), and they are one of only five reptile species that are protected in the state of Arizona (AGFD 1996). Other threats to CRLE at CHIR, and elsewhere, include habitat destruction associated with collecting (Goode et al., 2004, 2005), and road mortality (Johnson & Mills, 1982). Another potential threat to CRLE, and the habitats and prey species on which it depends, is wildfire suppression and the subsequent potential for catastrophic wildfires.

The Mountain Spiny lizard (*Sceloporus jarrovii*, hereafter SCJA), one of the most studied lizards in the United States (e.g., Middendorf, 1993), is abundant at CHIR and in the surrounding Chiricahua Mountains. Although the distribution of SCJA is limited the United States, most of what we know about the biology of the species stems from studies in the Chiricahua Mountains (e.g., Middendorf, 1984; Middendorf & Simon, 1985). Although SCJA is common, large-scale disturbances, such as wildfires, may lead to population declines. Given the role of this species as a major food item for many predators, it may be a potential "keystone" species in "sky island" montane communities, as exemplified at CHIR. Potential effects of changes in lizard densities on predator populations remains speculative, but may be important in developing and implementing management plans for species of special concern, such as CRLE (Holycross et al., 2002).

Frequent low-intensity fires appear to be historically important in maintaining Madrean woodland ecosystems throughout the Desert Southwest (Swetnam & Baisan, 1996). Occurring at 5-8 year intervals during pre-settlement, dramatic reductions in frequency (Bahre, 1991) due to fire suppression have resulted in increased fuel loads, denser woodlands, and altered community composition. Because patterns of distribution and dispersal, and predator-prey interactions of wildlife are likely to have been strongly affected, contemporary land management agencies recognize the benefits of reintroducing fire as a management tool through the use of prescribed burns, management of naturally ignited fires, and reduced suppression efforts. Effective fire management should lead to reduced fuel loads, decreased frequency of catastrophic fires and associated erosion, lowered costs associated with fire suppression, and ultimately, increased ecosystem function and health.

As originally conceived, the CHIR fire management plan would provide us with a unique opportunity to study the effects of prescribed burns on CRLE and their primary prey, SCJA. Proposed objectives of this study were: (1) continued mark-recapture efforts of rattlesnakes and lizards in hopes of estimating population density and structure; (2) acquisition of data on vegetation, habitat, and insect density to assess differences before and after fire; (3) examination of potential effects of fire on movement and dispersal patterns of lizards; and, (4) combining snake and lizard data to examine the effects of fire on their predator-prey relationship. Unfortunately, we were unable to obtain post-burn data, because fire managers did not burn our treatment plot to the extent and with the intensity as originally planned due to the drought conditions during the summer of 2003. However, we were able to add another year of pre-burn data to our existing data from 2003 (Goode & Amarello, 2004). In this report, we present 2004 data, and compare it to previous data collected in 1999 (Prival & Schwalbe, 2000) and 2003 (Goode & Amarello 2004).

METHODS

Study Area

We surveyed for CRLE and SCJA in lower Rhyolite Canyon and Madrone Canyon near the Visitor Center (Figure 1). We chose survey sites based on the known occurrence of a dense population of CRLE in the area (Prival & Schwalbe, 2000), and the park's fire management plan (Gebouw & Halvorson, 2002). Three of the four rattlesnake sites were comprised of mountainous terrain with extensive talus slides on steep slopes, bisected by deep side drainages. Most of Site 3 had talus slides and Sites 1 and 2 had talus slides, but to a lesser degree. In the fire management plan, Sites 1, 2 and 3 were scheduled to be burned in 2005, although to our knowledge, this has still not occurred. Site 4, Madrone Canyon, is a smaller side canyon that flows into Rhyolite Canyon near the Visitor Center, which was supposed to burn a few weeks after our final survey period in 2003, but did not burn to the extent and as intensely as we had hoped. Site 4 has very little talus, but it does have boulder piles spaced throughout the drainage, which provide important basking sites and cover for rattlesnakes and lizards alike. The SCJA mark-recapture sites (A, B, & C) overlapped rattlesnake sites, but mainly comprised side drainages. Vegetation cover for all sites was representative of typical Madrean Woodland communities (Figure 2)., consisting mostly of oaks (*Quercus sp.),* Arizona cypress (*Cupressus arizonica*) and manzanita (*Arctostaphylos sp.).* The entire study area could be characterized as overly dense in understory vegetation, consistent with a fire-suppressed woodland in the northern Madrean ("sky-island") region of the southwestern United States and northern Mexico.

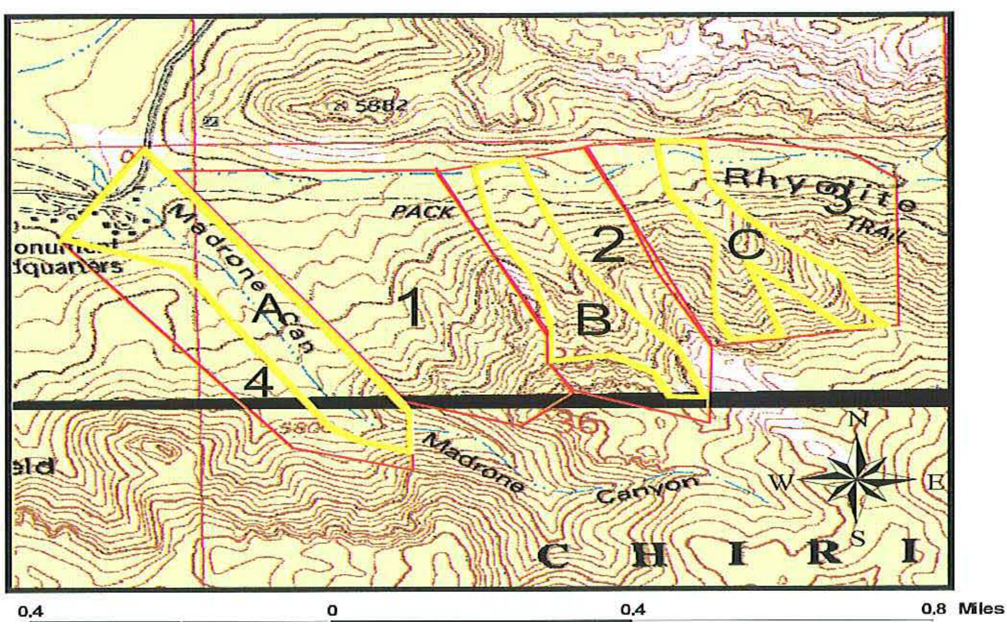

Figure 1. Topographic map showing four Banded Rock Rattlesnake sites in red (1, 2, 3, 4) and three Yarrow's Spiny Lizard sites in yellow (A, B, C).

Figure 2. Photograph taken from the ridge top on the south side of Rhyolite Canyon at Chiricahua National Monument in 2003 showing the rocky slopes and canyon bottom woodlands frequented by Banded Rock Rattlesnakes and Mountain Spiny Lizards.

Snake Surveys

We conducted visual encounter surveys on foot in all four of our survey sites. The four sites covered a total of 8.7 hectares. Anywhere from one to nine people at a time searched for snakes. We typically conducted surveys between 0800-1200, depending on weather conditions and time of year. On days when surveys were particularly productive, we often continued searching until we stopped finding snakes. On a few occasions, we conducted surveys from sunset into early evening for 1-3 hours. We conducted surveys intermittently on a total of 50 days from July 7 to September 26, 2004.

During surveys, we walked slowly while scanning for rattlesnakes, and listening for their rattle. We also obtained GPS coordinates for all SCJA encountered. We usually found rattlesnakes after hearing their rattle; however, we found some snakes that were silently basking or moving. CRLE, like all diminutive montane rattlesnakes, have relatively small rattles that sound similar to buzzing insects and can be difficult to hear for some people. Therefore, the observer must remain extremely alert during surveys, as CRLE also tend to rattle briefly while simultaneously attempting to rapidly escape into cover. The observer must react quickly or risk missing the snake, especially in deep talus. Whenever we saw or heard a rattlesnake, we attempted to quickly capture it with long forceps (ca., 18") or by hand using welding gloves through which snakes were unable to bite. A few snakes, typically those found on talus or in boulder piles, managed to escape before we could capture them. For each CRLE encountered, we recorded weather, habitat use, behavior, GPS coordinates, and number and species of lizards within 5 m.

We investigated habitat use by CRLE at different spatial scales. At the landscape scale we recorded whether or not snakes were found on a slope or in a canyon bottom. We also recorded whether or not snakes were found on or away from talus. In addition, we identified the substrate upon which each snake was found, which included leaf litter, rock, or bare ground. We measured a variety of microhabitat variables associated with each snake capture location. We chose these variables based on previous work by Prival & Schwalbe (2000) who conducted an analysis of microhabitat use by CRLE at CHIR. The variables we chose to measure were those that Prival & Schwalbe (2000) found to be statistically significant. These variables were aspect, distance to nearest tree, distance to nearest ground vegetation, percent tree cover > 2 m, percent shrub cover > 2 m, and percent grass cover (cf., Prival and Schwalbe 2000). Any snakes that were captured were taken back to a trailer (provided by the park) in nearby Pinery Canyon where they were "processed". Processing included determination of sex via cloacal probing, mass and snout-vent length (SVL) measurements, head width and length measurements, assessment of female reproductive condition via hand palpation of ova or embryos, and subcutaneous insertion of a tiny passive integrated transponder (PIT) tag for permanent identification. We collected feces from snakes, which were later used in diet analyses. We also classified each snake as an adult, juvenile or neonate. We considered a snake to be a juveniles if its SVL was 332 mm or greater, which is the smallest known size of a reproductively active individual for CRLE (Prival & Schwalbe, 2000). Lastly, each individual was given a unique 3-digit number, with each digit corresponding to a particular paint color. We painted the first three segments of the rattle, starting with the basal segment, which enable us to easily identify each snake without capturing it, and also indicates how many times the snake has shed since last captured.

Mountain Spiny Lizards

We conducted SCJA surveys during the month of July at each site (A, B, & C). We searched from 0730 to 1300, weather permitting. Two to three people searched one site at a time. We recorded GPS coordinates, ambient temperature, wind speed and direction and cloud cover for each lizard sighting. We attempted to capture each lizard encountered using noose poles. We marked all SCJA and Striped Plateau Lizards (*Sceloporus virgatus*, hereafter known as SCVI) captured by both painting a unique number on their dorsum, and by clipping their toes according to the unique identification number. We also recorded mass, snout-vent length (SVL), sex, and general body condition for each lizard caught.

Vegetation Sampling

Given the scope of this project, a thorough vegetation analyses for each lizard survey site was not possible. However, we did count the number of oak (*Quercus* spp.) and pine (*Pinus* spp.) trees in each site, as a qualitative measure of relative canopy cover. We have found number of dominant trees to be a good indicator of relative abundance of SCJA, and it is also an easy variable to assess pre- and post-fire.

Insect Trapping

We used commercially available insect sticky traps to quantify insect relative abundance. We placed sticky traps on the ground every 10 m along the bottom of the drainage of all three survey sites. Although we identified insects to the level of order in most cases, we ended up combining all insects trapped for the purposes of this report. In the absence of detailed information on SCJA diet, we felt justified in reporting total individuals trapped to investigate potential differences in insect relative abundance.

Road Cruising

Road cruising is a common method for finding nocturnally active reptile species, especially snakes that can be difficult to observe during daytime foot searches. Although CRLE have occasionally been observed on park roads at night (K. Bonine, SDNIMP herpetologist; S. Mazur, CHIR law enforcement ranger, personal communication), we did not expect to find a large number while road cruising. We typically began road cruising at the park entrance, driving past the Visitor Center and up Bonita Canyon for several miles. We often drove this route 2-3 times per evening if conditions were favorable, truncating our activities when temperatures decreased to the point of limiting snake activity. We recorded date, time and location of each individual amphibian and reptile observed, and we captured all rock rattlesnakes for eventual processing.

Data Analyses

We did not conduct mark-recapture analyses on CRLE, as originally planned, because recapture rates were simply too low. Although Prival & Schwalbe (2000) conducted mark-recapture analyses, their population estimates have extremely large confidence intervals and are, therefore, of limited value. Because our recapture rates were much lower, we felt that mark-recapture analyses would not produce meaningful results. The low number of recaptures in our study surprised us, because Prival & Schwalbe (2000) had higher recapture rates, even though they did not focus all of their efforts in Rhyolite Canyon, where CRLE are apparently most abundant. Below, we discuss possible factors associated with why our recapture rates were low, and we suggest the use of parameters such as relative abundance, body size, and age-class structure to monitor the effects of fire rather than population size for which reliable estimates can be difficult to produce.

Species List

Although not a specific objective of this study, we compiled a list of all amphibians and reptiles observed (Appendix B). These data were given to the Sonoran Desert Network Inventory and Monitoring Program to aid in their efforts to document amphibians and reptiles inhabiting CHIR. Amphibians and reptiles are often secretive and only active for part of the year, making it difficult to document presence/absence. Therefore, it is important to record all species (and for many species all individuals) of amphibians and reptiles encountered while conducting research in parks. It is not uncommon for rare species to be documented by researchers who are not directly involved in inventory and monitoring activities.

RESULTS

Surveys and Relative Abundance

Banded Rock Rattlesnakes

We obtained data on a total of 59 CRLE (Appendix A), which we recaptured 29 times during the 2004 field season, 48 of which we captured during snake surveys, and 11 of which we captured while road cruising (Table 1; Figures 3, 4). Of all snakes recaptured in 2004, 21 of these snakes had been caught before in previous years. In total, during 1999 and 2002-2004, 205 CRLE have been marked throughout the park. At our study sites, 132 of theses snakes have been marked, of which 55 individual snakes have been recaptured 81 times, often within the same year of their original capture. In 2004, we spent a total of 377.7 person-hours conducting snake surveys (Table 1), during which time we encountered 68 snakes (does not include hours searching and snakes found by the lizard crew or while road cruising). This equates to approximately 1 snake every five hours. We captured 28 snakes that had never been marked, and 20 snakes that had been marked in previous years. We encountered the most snakes per unit effort in Site 3, where it took an average of approximately 3 hours to find one snake. The lowest relative abundance of CRLE was in Site 4, where it took an average of 23 hours to find one snake.

Table 1. Number of Banded Rock Rattlesnakes (CRLE) found by site and per-person hour at Chiricahua National Monument in 2004. Total includes number of snakes found by the lizard crew, recaptures, and snakes that escaped. 1 = Lower Rhyolite Canyon section 1; 2 = Lower Rhyolite Canyon section 2; 3 = Lower Rhyolite Canyon section 3; 4 = Madrone Canyon.

Site	# of CRLE Encountered	Person Hours	CRLE/Person Hours
1	14	94.7	0.15
2	18	96.5	0.19
3	34	94.2	0.36
4	2	46.1	0.04
Road	11	46.1	0.26
Lizard Crew	9	--	--
Total	**88**	**377.7**	**0.24**

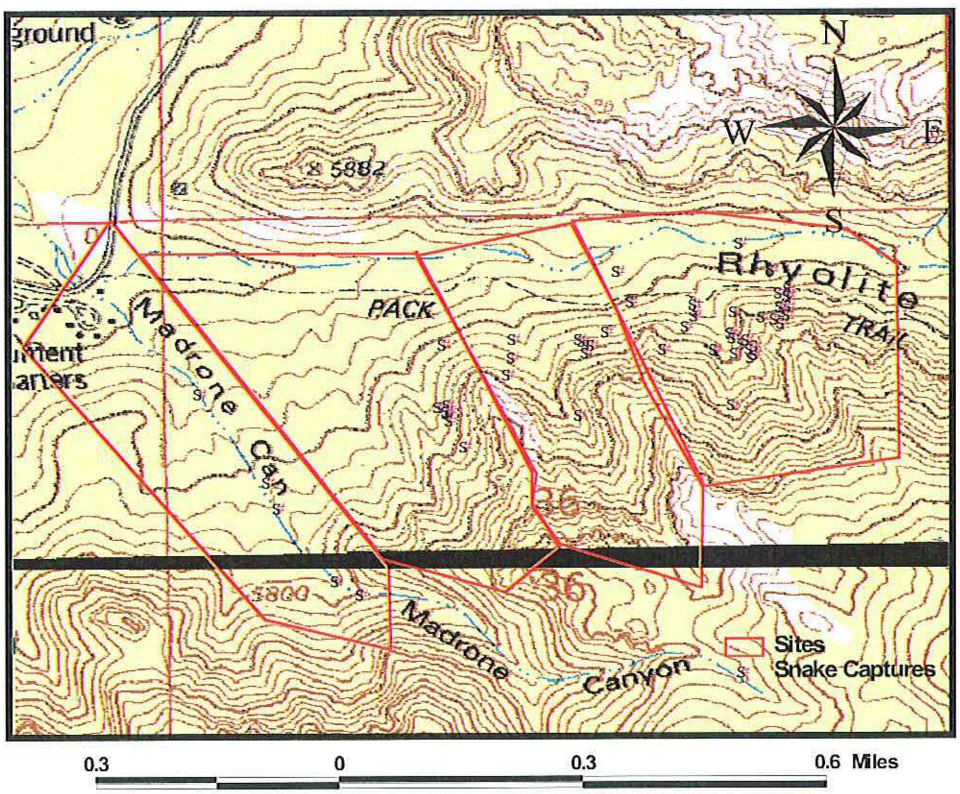

Figure 3. Topographic map showing the locations of all capture locations (N = 77) of Banded Rock Rattlesnakes (*Crotalus lepidus*) observed at Chiricahua National Monument during snake surveys in lower Rhyolite Canyon in 2004.

Road Cruising

We observed 11 CRLE while conducting road cruising surveys along a 6.8 km segment of road leading from the park entrance to the point at which the road leaves Bonita Canyon and climbs to upper elevations in the eastern part of the Monument (Figure 4).

Although we spent the majority of our time in Bonita Canyon specifically looking for CRLE, we frequently drove the road above and below the area where we encountered all the Banded Rock rattlesnakes.

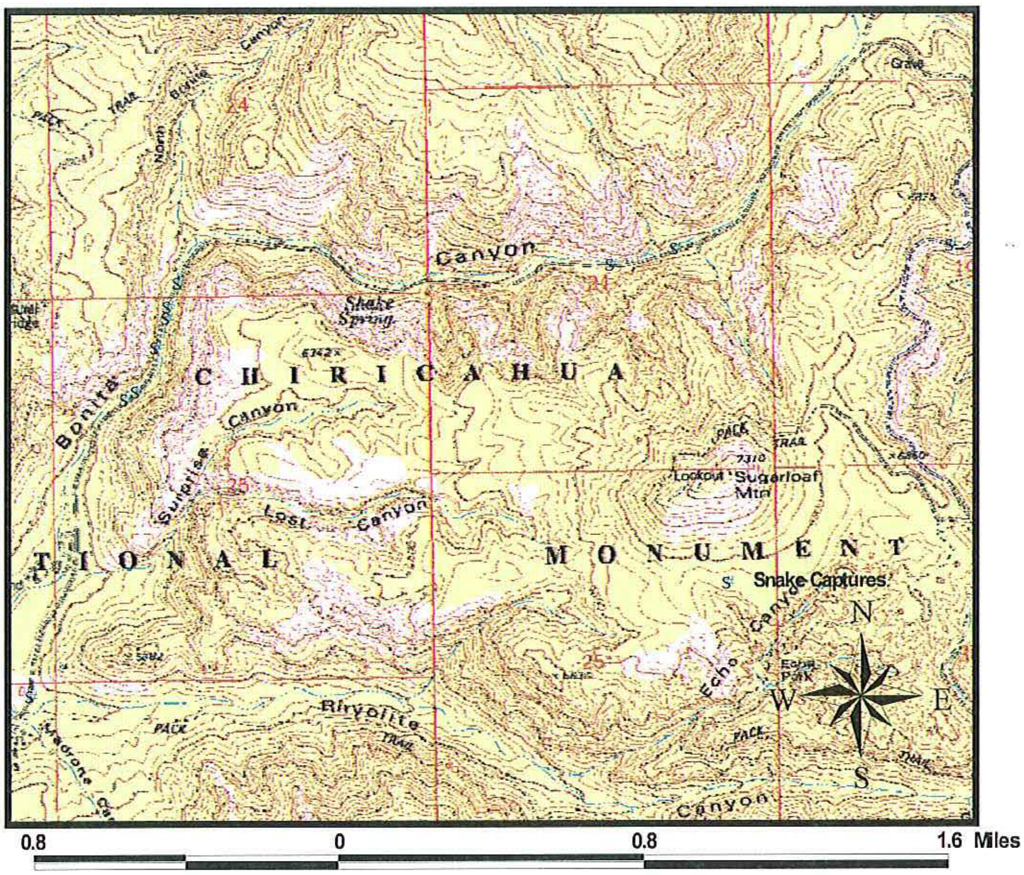

Figure 4. Topographic map showing locations of 10 of the 11 Banded Rock Rattlesnakes (*Crotalus lepidus*) observed on the main road that runs through Bonita Canyon in Chiricahua National Monument while road cruising in 2004.

Mountain Spiny Lizards

We spent a total of 123.5 person hours searching for SCJA and SCVI in 2004 (Tables 2, 3), during which time we marked 112 and observed 203 lizards. We observed markedly different numbers of lizards of both species depending on site and year (Figure 5).

Table 2. ***Sceloporus jarrovii*** **observed, marked, person hours, and number of lizards marked per person hour by site for 2004 (2003).**

Site	Observed	Marked	Person Hours	Marked/Person Hours
A	77 (48)	38 (30)	48.6 (50.7)	0.8 (0.6)
B	55 (69)	30 (34)	34.9 (42.4)	0.9 (0.8)
C	30 (44)	20 (23)	40.0 (40.1)	0.5 (0.6)
Total	**162 (161)**	**88 (87)**	**123.5 (133.2)**	**0.7 (0.7)**

Table 3. ***Sceloporus virgatus*** **observed, marked, person hours, and number of lizards marked per person hour by site for 2004 (2003).**

Site	Observed	Marked	Person Hours	Marked/Person Hours
A	41 (29)	24 (18)	48.6 (50.7)	0.6 (0.4)
B	0 (2)	0 (2)	34.9 (42.4)	0 (0)
C	0(0)	0 (0)	40.0 (40.1)	0 (0)
Total	**41 (31)**	**24 (20)**	**123.5 (133.2)**	**0.2 (0.2)**

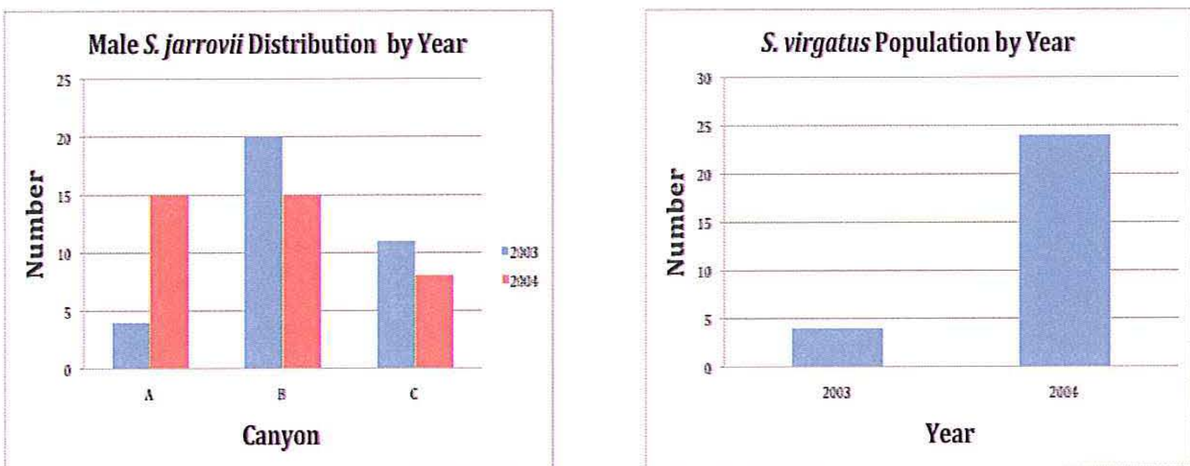

Figure 5. Variation in number of male ***Sceloporus jarrovi*** **and** ***S. virgatus*** **observed among sites and between years.**

Population Structure

Banded Rock Rattlesnakes

We summarized processing data for CRLE (Table 4). We captured 39 males, 28 females and 2 snakes of unknown sex, of which 41 snakes were adults, 17 were juveniles, and 1 was a neonate. Overall, adult males were more likely to contain food bolus, were more likely to be caught, and significantly larger than females. Juvenile snakes were more likely to contain a food bolus, but less likely to have feces present in the hindgut. We captured 14 adult females, of which 5 were gravid (Table 5 and Appendix A). Gravid females were longer and more massive, less likely to contain a food bolus or fecal matter in the hindgut, and less likely to be recaptured than non-gravid females. The mean number of ova/embryos for 2004 was 2.6 ± 0.25.

Table 4. Summary of means and standard errors from data on Banded Rock Rattlesnakes captured at CHIR in 2004.

Age Class	Sex	#	SVL	Mass	Tail	Head Length	Head Width	% Fecal	% Bolus	% Gravid
Adult	Female	14	384.1±5.6	39.4±2.3	26.6±0.7	19.7±0.0	14.5±0.2	50%	36%	36%
	Male	27	432.6±9.4	52.3±3.1	40.8±1.0	21.8±0.3	16.0±0.3	19%	67%	
Juvenile	Female	4	297.7±11.8	22.6±3.8	21.2±0.8	14.9±5.3	12.8±0.2	25%	50%	
	Male	11	273.1±8.6	16.5±1.3	23.8±0.8	16.6±0.3	11.8±0.2	27%	73%	
	Unknown	2	271.5±1.5	12.2±0.2	21.5±2.5	16.9±0.1	11.7±0.2	0%	50%	
Neonate	Male	1	202	6	18	13.4	9.8	0%	100%	

Table 5. Reproductive condition of all female Banded Rock Rattlesnakes captured in 1999, 2003 and 2004 at CHIR that were gravid at least once. Not all of the females were found within the study sites.

Snake ID	1999	2003	2004
59	Embryos	Follicles	Embryos
62	Embryos	Follicles	Not Gravid
130	Embryos	--	--
131	Embryos	--	--
132	Embryos	--	--
93	--	--	Embryos
20	--	Embryos	--
22	--	Follicles or Embryos	Embryos
116	Not Gravid	--	Follicles

Habitat Use, Vegetation, and Insect Abundance

Banded Rock Rattlesnakes

We obtained habitat data from 65 CRLE encounters, 55 of which we found on slopes and 10 of which we found in canyon bottoms (Figure 6). We spent 71% of our time searching on slopes. We only spent 30% of our time searching canyon bottoms.

We also recorded substrata on which we found snakes (Figure 7). Approximately 70-75 % of males and non-gravid females, and 100% of gravid females were found on talus slopes. We knew that many of the snakes were typically found on talus slopes based on the 2003 dataset (Goode & Amarello 2004). In 2003, equal time was spent searching in both landscape types. In 2004, more time was spent looking for snakes on talus slopes to attempt to maximize the number of snakes caught. Fifty-three percent of our time searching was spent on talus. The other 47% was spent off talus.

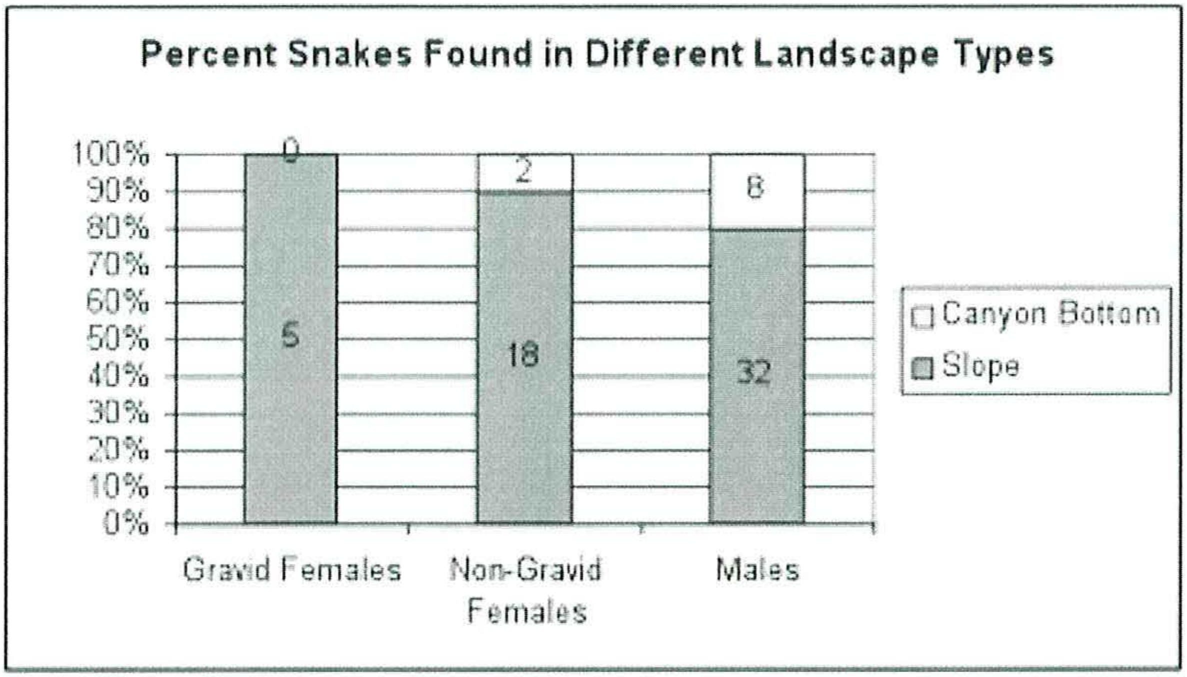

Figure 6. Banded Rock Rattlesnakes found on slopes or in canyon bottoms at CHIR in 2004.

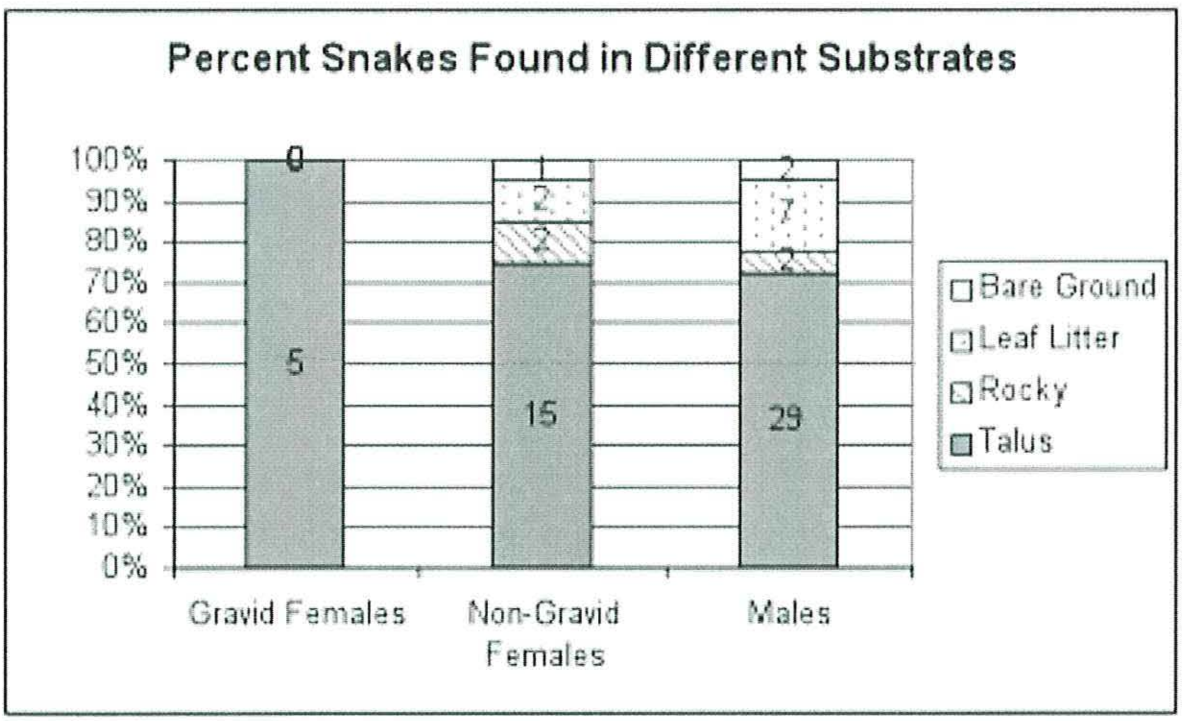

Figure 7. Banded Rock Rattlesnakes found by substrate type in Lower Rhyolite Canyon at CHIR in 2004.

None of the microhabitat variables we measured at CRLE locations varied significantly by sex or reproductive condition except for % shrub cover (Table 6). Gravid females were found in areas with slightly more shrub cover compared to non-gravid females and males. In 2003, the results were similar, but there was not a significant difference in reproductive condition and % shrub cover (Goode & Amarello 2004). This contrasted with Prival and Schwalbe (2000) who found that all of the variables we measured were significantly different. However, the number of gravid females in our study was low, and we only examined data for snakes from Rhyolite Canyon, but Prival and Schwalbe (2000) included data on all snakes captured throughout CHIR.

Table 6. Microhabitat features at Banded Rock Rattlesnake capture locations in 2004 at CHIR.

Variable	Snake category	n	Mean ± SE
Aspect Degrees	Gravid females	4	177.25±81.21
	Non-gravid females	19	236.42±30.73
	Males	40	176.23±22.75
Distance to Nearest Tree (m)	Gravid females	4	2.06±1.33
	Non-gravid females	12	2.42±0.56
	Males	31	1.50±0.21
Distance to Nearest Ground Vegetation (m)	Gravid females	4	0.22±0.08
	Non-gravid females	12	0.42±0.10
	Males	31	0.59±0.17
% Tree Cover (>2m)	Gravid females	4	8.75±3.75
	Non-gravid females	12	18.33±6.00
	Males	31	18.90±3.10
% Shrub Cover (<2m)	Gravid females	4	31.25±4.27
	Non-gravid females	12	10.58±1.71
	Males	31	13.65±2.85
% Grass Cover	Gravid females	4	2.00±1.00
	Non-gravid females	12	1.25±0.52
	Males	31	1.52±0.40
% Green from 1 meter	Gravid females	4	32.50±17.85
	Non-gravid females	12	25.75±9.00
	Males	31	24.03±4.23
% Green from Air	Gravid females	4	48.00±10.16
	Non-gravid females	12	51.75±8.02
	Males	31	47.84±4.25

Mountain Spiny Lizards

We observed varying numbers of SCJA (Table 2), depending on site and on type of trees present (Figure 8). In general, we observed fewer lizards at Site 3, which had the lowest number of trees, and we observed more lizards at Site 2, which had the greatest number of trees.

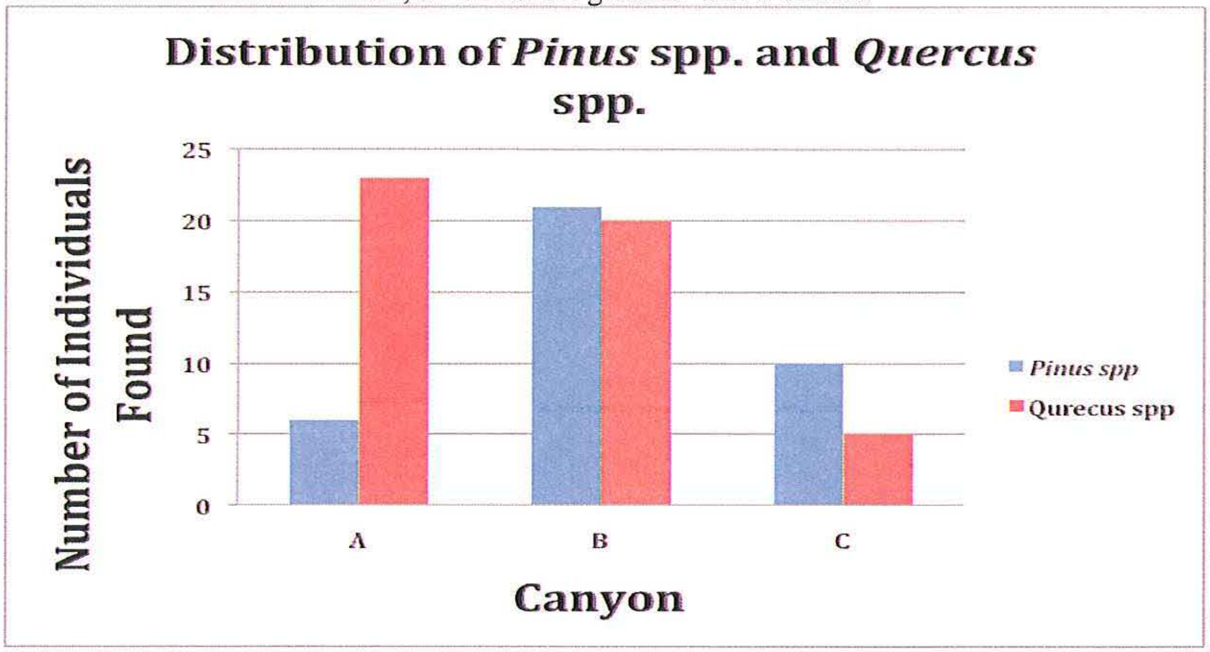

Figure 8. Number of trees (*Pinus* and *Quercus* species) found on all three lizard mark-recapture sites at CHIR.

Relative abundance of insect prey was actually highest at Site C (Figure 9), where we observed the least number of SCJA (Table 2).

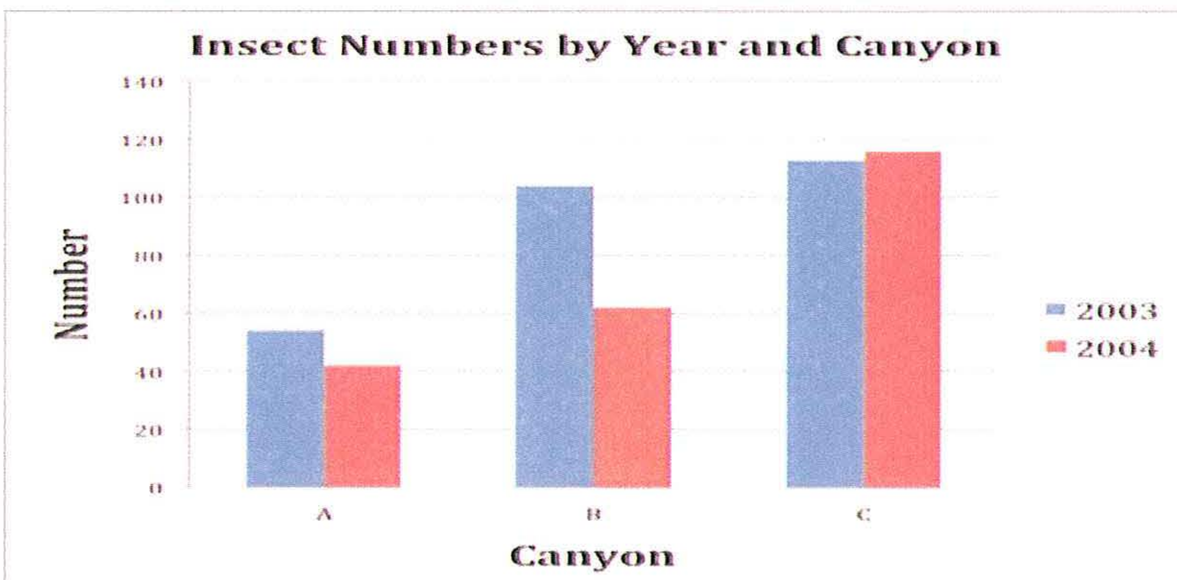

Figure 9. Number of insects trapped by site and by year on SCJA mark-recapture sites at CHIR from 2003-2004.

Rainfall Data

The number of snakes captured was closely related to the amount of rainfall in 2004 (Figure 10). During rainy periods, we generally captured more snakes than during dry periods. Interestingly, there was another peak in rainfall in late September, but relatively few snakes were captured. This may be due to many factors. We only searched for two days during that two-week period compared to the other periods where we searched 8-10 days in a two-week period. September is the tail end of the breeding season for CRLE. The temperatures in September tend to be cooler than in July also, so the snakes may be less active, and therefore less likely to be observed.

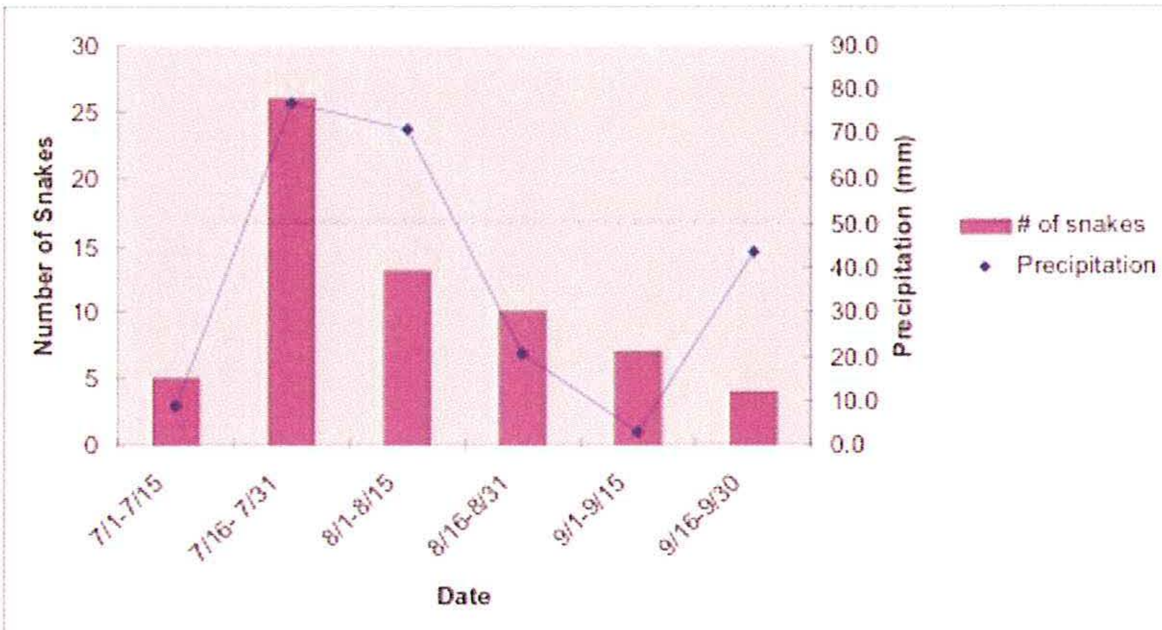

Figure 10. Rainfall and number of Banded Rock Rattlesnakes encountered from July through September 2004 at CHIR.

Movement Patterns

Banded Rock Rattlesnakes

We were unable to obtain as much information as we wanted on movement patterns and behavior on CRLE. Ideally, we would have used radio-telemetry, but what we have available is mark and recapture data. Since we did not have as much recaptures as we hope we combined the datasets from 1999, 2002, 2003, and 2004 to speculate on minimum "home ranges" sizes (Figure 11) We had 7 females of which 3 had been gravid at least once, and seven males that had 3 or more capture events. Using minimum convex polygons, we can speculate how the snakes have moved. Interestingly, female #59 was gravid every year we captured her and thus far she is the snake that has moved the most. All of the snakes we caught 3 or more times were on slopes and not in canyon bottoms except male #100.

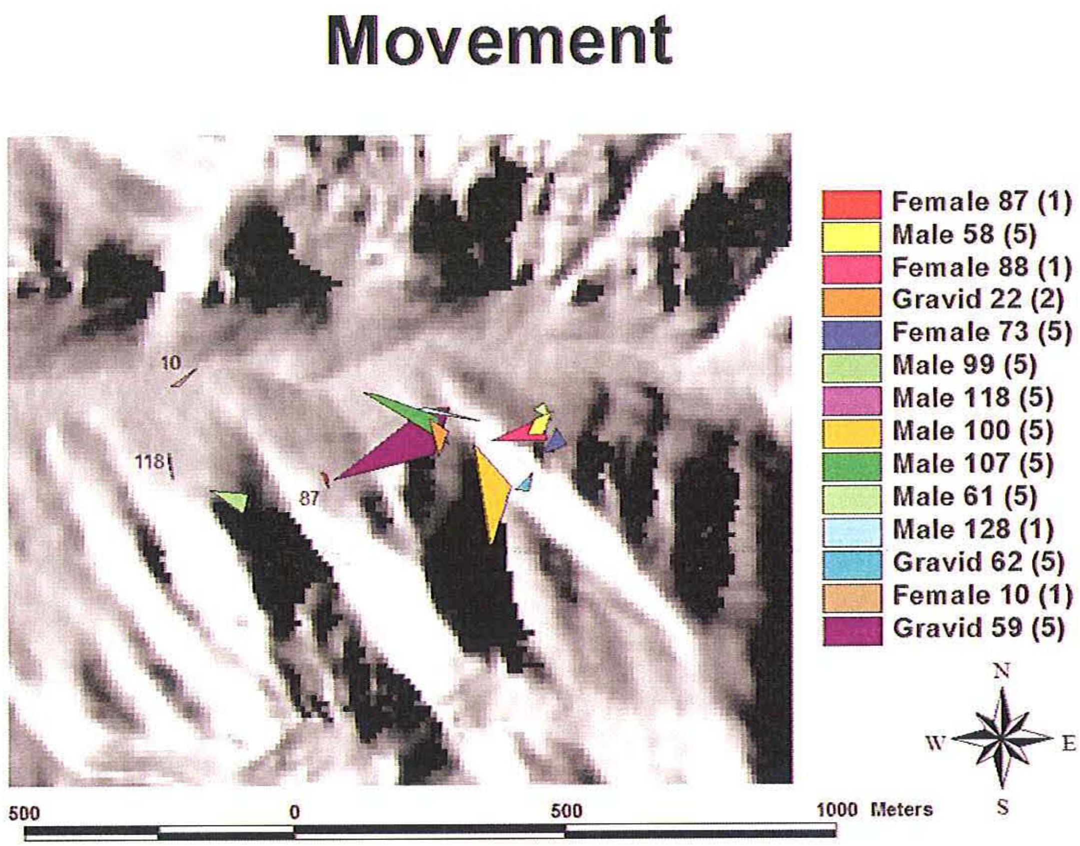

Figure 11. Capture locations of individual snakes caught 3 or more times from 1999-2004. *Numbers to the right are snake id and number of years the data spans are in parentheses.

Interactions Between CRLE and SCJA

We obtained 40 fecal samples over 2002, 2003, and 2004, that we were able to determine what the prey was. Of the samples taken, 67% (N=27) contained only centipede (*Scolopendra sp.*) parts. Two samples (5%) contained both reptile scales and centipede parts. Ten samples (25%) contained only reptile parts (scales, claws, teeth). Only 1 sample (3%) we were sure of had mammal parts (hairs, teeth and claws). None of the samples contained bird parts.

DISCUSSION

In 2004, we captured more males than females as is often the case with snake populations characterized by a polygynous mating system. However, this differed from the 2003 field season when numbers of males and females were almost equal. This may be due to differences in where searching occurred over the field season given that males and females differ in their habitat selection. For example, we observed all gravid females on talus, and our search efforts are often out of proportion to the relative availability of talus.

Another obvious pattern is the importance of rainfall to relative abundance (or at least encounter rates) of CRLE. Humid conditions associated with rainfall likely enable snakes to remain above ground and active, whereas dry conditions may threaten snake with harmful water imbalances. Interestingly, our limited data indicate that rainfall doesn't seem to effect encounter rates for SCJA or SCVI.

Limited data on diet suggests that this population of CRLE eats primarily centipedes as opposed to lizards. This may be due to the fact that body size is smaller than other CRLE populations with which we are familiar. Perhaps the dense population of snakes present results in smaller body size, which is reflected in the diet, with smaller snakes choosing centipedes.

ACKNOWLEDGMENTS

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Appendix A

Raw data from 59 Banded Rock rattlesnakes (*Crotalus lepidus*) captured at Chiricahua National Monument in 2004.

PIT Tag	#	AGE CLASS	SVL	Tail	Mass	HeadWidth	HeadLength	Sex	Gravid
985120005771308	3	A	524	53	100	19.8	25.9	male	
985120007814440	14	A	434	43	54.5	15.6	22.4	male	
985120005456934	19	A	353	26	35.3	13.8	18.9	female	N
985120006191411	21	A	365	21	31.3	13.7	19.8	female	N
985120005721190	22	A	383	26	44.1	14.9	19.4	female	Y
985120005856770	26	A	549	50	85.5	17.4	25.4	male	
985120005978128	35	J	301	23	19.8	12.9	17.2	female	N
985120007995433	38	J	286	25	14.5	11.7	19.2	male	
985120008008140	49	A	346	38	33.8	15	18.6	male	
5028384744	58	A	392	40	37.6	15	20.6	male	
40644B5A0E	59	A	414	32	60.7	15	20.5	female	Y
5027754A50	61	A	370	39	33.6	13.5	19.6	male	
4064454878	62	A	383	24	43.8	14.1	20.5	female	N
985120005152801	64	J	330	22	34	13.4	18.4	female	N
5030470B7F	73	A	414	28	42.2	15.5	20.5	female	N
985120011452537	76	A	416	43	51.3	15.9	22.4	male	
Too small to tag	77	J	270	19	15.5	11.5	16.8	unknown	
985120005914880	78	A	490	42	49.1	17.1	24.5	male	
985120006533778	79	A	373	28	45.8	15.4	20.9	male	
985120008702392	80	J	273	24	15	12	17.2	unknown	
985120006171192	81	A	487	44	64.9	17.6	23.1	male	
985120013139116	82	A	359	29	29.3	13.7	19.7	male	
985120007935863	83	A	462	38	59	16.9	24.4	male	
985120011342439	84	A	480	46	66.5	19.7	23.8	male	
985120008629199	85	A	460	44	69	18.1	22.7	male	
985120007470938	86	J	291	20	18.4	11.9	16.8	male	
985120009705913	87	A	405	27	38.8	16	20.6	female	N
985120008603947	88	A	361	26	36.8	15.3	19.3	female	N
985120007921534	89	A	462	42	62	17	22.7	male	
985120008058700	90	J	300	28	19.2	12.4	17.3	male	
985120006078647	91	J	278	21	20.1	12.7	17.1	female	N
985120013239341	92	A	377	28	32.7	15	20.7	female	N
985120007392664	93	A	401	30	47	14.7	19.1	female	Y
985120008600641	94	A	363	26	27.5	14	19	female	N
985120006230792	95	A	417	39	43.1	15.4	21.1	male	
985120015141025	96	J	303	25	23.2	13.1	17.3	male	
985120008389702	97	A	397	25	33.8	14.4	20.1	female	N
985120005355894	98	J	302	28	19	12.5	17	male	
5028252224	99	A	445	40	62	15.5	21.2	male	
50277B0067	100	A	422	39	45.4	15	20.4	male	

985120009757581	101	A	422	45	53.2	15.8	21.3	male	
985120009194443	102	J	279	25	21.1	12.6	17.1	male	
985120007437741	103	J	278	24	17.7	12.2	16.2	male	
985120009264932	104	A	395	40	42.7	14.7	20.5	male	
985120008106327	105	A	394	40	40.6	14.5	20.5	male	
985120007372074	106	A	443	44	49.2	15.2	21	male	
50277A100D	107	A	440	42	53.6	17.2	22.6	male	
985120009531566	108	A	415	39	32.3	14.8	19.8	male	
985120012016381	109	J	241	20	10.6	11.3	15.4	male	
985120010603820	110	N	202	18	6	9.8	13.4	male	
985120009426957	111	J	217	20	7.7	10.3	15.1	male	
985120007541346	112	J	242	23	13.3	11.2	15.4	male	
985120014260762	113	J	265	24	17.6	11.1	16.4	male	
985120007390327	114	A	362	25	32	13.5	18.7	female	Y
5028350E17	115	A	408	35	45.6	15.6	21	male	
4064627D54	116	A	399	29	46.4	14.4	19.5	female	Y
985120008655602	117	J	282	19	16.7	12.2	6.9	female	N
5028025545	118	A	411	38	40.3	15.6	21.6	male	
50303A215B	119	A	465	43	64.2	16.9	23.5	male	

Appendix B

All species of reptiles and amphibians encountered during snake surveys and while road cruising at Chiricahua National Monument in 2004.

Scientific Name	*Common Name*
Aspidoscelis exsanguis	Chihuahuan Spotted Whiptail
Aspidoscelis sonorae	Sonoran Spotted Whiptail
Bufo cognatus	Great Plains Toad
Crotalus lepidus klauberi	Banded Rock rattlesnake
Crotalus molossus	Black-tailed Rattlesnake
Elgaria kingii	Madrean Alligator Lizard
Eumeces obsoletus	Great Plains Skink
Hyla arenicolor	Canyon Treefrog
Hypsiglena torquata	Night Snake
Lampropeltis pyromelana	Sonoran Mountain Kingsnake
Leptotyphlops sp.	Blind Snake
Masticophis bilineatus	Sonoran Whipsnake
Pituophis catenifer	Gopher Snake
Sceloporus clarkii	Clark's Spiny Lizard
Sceloporus jarrovii	Mountain Spiny Lizard
Sceloporus virgatus	Striped Plateau Lizard
Senticolis triapsis	Green Ratsnake
Spea multiplicata	Mexican Spadefoot
Trimorphodon biscutatus	Lyre Snake
Urosaurus ornatus	Ornate Tree Lizard