DIET OF *Crotalus lepidus* (SERPENTES: VIPERIDAE) IN MESA MONTORO, AGUASCALIENTES, MEXICO

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Abstract.— This study describes the diet of *Crotalus lepidus* based on the analysis of the stomach contents and scats of 13 specimens from Mesa Montoro, Aguascalientes, Mexico. We found 14 items belonging to four prey categories. The most important prey category were lizards, with a frequency of occurrence of 61.53% and percentage of appearance of 64.28%, followed by mammals with 23.07% and 21.42% respectively. Also found the category of snakes and birds but in a lesser proportion. Although presents a diverse diet, the data suggests that *C. lepidus* in Mesa Montoro is a specialist predator.

Keywords.— Banded Rock Rattlesnake, Sierra Fria, Preys.

Resumen.— En este estudio se describe la dieta de *Crotalus lepidus* con base al análisis de contenidos estomacales y excretas provenientes de 13 ejemplares de Mesa Montoro, Aguascalientes, Mexico. Se encontraron 14 elementos pertenecientes a cuatro categorías de presa. La categoría mas importante fue lagartijas, con una frecuencia de ocurrencia de 61.53% y un porcentaje de aparición de 64.28%, seguido por mamíferos con un 23.07% y 21.42% respectivamente. También se encontró la categoría de serpientes y aves pero en menor proporción. Aunque presenta una dieta diversa, los datos sugieren que *C. lepidus* en Mesa Montoro es un depredador especializado.

Palabras clave.— Cascabel Bandeada de las Rocas, Sierra Fria, Presas

Data of species diet is useful for understanding distribution patterns, habitat use, reproductive strategies, evolutionary divergence in the feeding ecology, as well as providing data for proposing conservation strategies (Taylor 2001). The encounter with snakes in the wild is irregular and even more difficult to observe an animal in the process of feeding. Hence, there is limited information on diet and predation behavior based on field observations (Bernarde et al. 2000). The composition of the diet is closely related to habitat, and thus their microhabitat preference is related the location of their prey (Hartmann 2005). This is why the diet studies are particularly important for understanding the biology of snakes, since it is the primary force in the evolution of morphology and behavior (Holycross et al. 2002). The usefulness of studies of diet composition depends on the accuracy of identification of ingested prey. Because many snakes consume large prey, rarely, most of the snakes captured have empty stomachs. Individuals with stomach contents also typically contain one or a few items, thus reducing the power of statistical comparisons (Halstead et al. 2008). Rattlesnakes generally feed on vertebrates, although they eat invertebrates when they are young (Campbell and Lamar 2004). Because of this change, the diet of specialized

predators may vary with age and size, between sexes and between individuals, depending on seasonal and geographical location (Greene 1997).

In Aguascalientes, Mexico, there is limited detailed information on the biology of most of the snakes, hence natural history studies are needed to generate information useful for conservation of species. Here we describe the composition of the diet of *Crotalus lepidus* in Mesa Montoro, Aguascalientes, Mexico, with the aim of increasing knowledge about the natural history of the snakes in the state.

Fieldwork was conducted in the locality of Mesa Montoro (21.995728°N, 102.576407°W; datum WGS84) 2406 m elev., located south of the Sierra Fria, between the Municipality of Calvillo and Jesus Maria, Aguascalientes, Mexico. The dominant vegetation is oak forest (*Quercus* spp.,) with patches of shrubs (*Arctostaphylus pungens, Arbutus glandulosa*) and grassland *(Bouteloua* spp., *Mulenberghia* spp.) with anthropogenic modifications such as livestock and agriculture. Twenty-three surveys were conducted between January 2008 and March 2009, with a team of three people accumulating 700 hours of effort. The search was conducted in the microhabitat available. When a snake was found, the snout-vent length was measured as well as tail length, weight, sex, number of segments and rattle shape. We palpated the snake in search of stomach contents or scats obtained by forced regurgitation and gentle palpation of the last third of body, respectively (Fitch, 1987). The date of capture of each snake was recorded also air temperature and relative humidity and georeferencing with a GPS (Garmin). The contents and scats obtained were identified using keys and the reference collection of the Vertebrates Collection of UAA (Moore et al. 1974, Knox and Manning 1992, Monroy-Vilchis and Rubio-Rodriguez 2003). To determine the diet, the frequency of occurrence was calculated, expressed as the percentage of samples where a prey species appears relative to the number of total samples. To consider the importance of all species, the percentage of appearance was calculated, expressed as the percentage of samples where a prey species appears relative to the number of total appearances (Aranda et al. 1995).

We examined 34 snakes, of which 21 (61.7%) did not have stomach contents or scats. Six (17.6%) had stomach contents (one male, three females and two juveniles). Prey items were *Peromyscus maniculatus* (males), *Sceloporus torquatus* (female), *Sceloporus grammicus* (males) and *Lampropeltis mexicana* (female). All preys were ingested head first. We obtained seven (20.5%) scats (four males and three females) all with identifiable items. Eight items were found in seven samples, and only one snake had two types of items*. Two (25%) *Sceloporus jarrovii*, one (12.5%) *S. brownorum*, one (12.5%) *S. grammicus*, one (12.5%) *S. torquatus*, one (12.5%) *Phrynosoma orbiculare*, one (12.5%) *Sigmodon hispidus* and one (12.5%) bird, probably a passerine. The values of frequency of occurrence and percentage of appearance are shown in Table 1.

Table 1. Frequency and occurrence (FO%) and Percentage of appearance (PA%) of preys in the diet of *Crotalus lepidus* from Mesa Montoro, Aguascalientes. * indicates that prey items come from the same sample.

Prey item	Contents	Scats	Total Samples	FO%	Appearances	PA%
Mammals						
Peromyscus maniculatus	2	0	2	15.38	2	14.28
Sigmodon hispidus	0	1*	1	7.69	1	7.14
Lizards						
Sceloporus sp.	3	5*	8	61.53	8	57.14
Phrynosoma orbiculare	0	1	1	7.69	1	7.14
Snakes						
Lampropeltis mexicana	1	0	1	7.69	1	7.14
Birds						
Unidentified	0	1	1	7.69	1	7.14
Total	6	8	13	100	14	100

The results show that *C. lepidus* has a marked preference for eating lizards, in particular of the genus *Sceloporus*. This preference is consistent with that indicated by Werler and Dixon (2002) and Ernst and Ernst (2003) on diet of *C. lepidus*. *Sceloporus* sp. accounted for 57.14% of the diet of *C. lepidus* in Mesa Montoro, this coincides with the results obtained by Holycross et al. (2002), stating that only *S. jarrovii* comprises 45% of total prey. This preference for *Sceloporus* was reported by several other authors (Campbell and Lamar 2004, Vazquez-Diaz and Quintero-Diaz 2005, Lemos-Espinal and Smith 2008, Lemos-Espinal and Smith 2009). In the case of *Phrynosoma orbiculare*, Ernst and Ernst (2003) and Campbell and Lamar (2004) mentioned that *C. lepidus* eat lizards of this genus occasionally, but this is the first record of this species (Carbajal-Marquez et al. 2012). Since *C. lepidus* inhabits rocky and rough places (Werler and Dixon 2000, Holycross et al. 2002, Ernst and Ernst 2003, Campbell and Lamar 2004, Vazquez-Diaz y Quintero-Diaz 2005) which agrees with our observations, may explain the higher percentage of occurrence of the genus *Sceloporus* in the diet, as these lizards are found in rocky sites. A large number of *C. lepidus* were found in stone walls built to divide land property, probably due to the fact that large number of *Sceloporus* lizards are found concentrated there.

It has been reported that *C. lepidus* consume mammals to a lesser extent (Werler and Dixon 2000, Holycross et al. 2002, Ernst and Ernst 2003, Campbell and Lamar 2004, Vazquez-Diaz and Quintero-Diaz 2005), this is reflected in the results, where mammals represent 24.9% of the diet. Holycross et al. (2002) mentions *Peromyscus boylii* as the most frequently consumed mammal by *C. lepidus* in many of the habitat it occupies, *P. boylii* was found in the study area, but does not appear as prey of *C. lepidus* , in its place *P. maniculatus* was found. A higher predation of lizards over the rodents can be explained probably by the site location of the study, it is above 2300 m elev., which probably causes the snakes to be mainly active during the day, and to a lesser extent during the night (reaching minimum temperatures of 8°C in the warmer months), so that its activity overlaps more with lizards to a lesser extent with rodents.

Neonates, juveniles and some adults have yellow at the tip of the tail, which can function as a lure to attract lizards, this pigment shows an adaptation to deceive and with this strategy consume this type of prey (Werler and Dixon 2000, Holycross et al. 2002, Ernst and Ernst 2003, Lemos-Espinal and Smith 2008). Neonates and juveniles were found mainly in stumps and fallen trees, habitat of *Sceloporus grammicus*, which was the type of prey found in the neonates. The intake of a snake *Lampropeltis mexicana* represents 7.14%, suggesting that their intake was occasional, and represent a new item. There are several reports of snake predation and cannibalism by *C. lepidus*, such as the ingestion of *C. lepidus, Gyalopion canum, Virginia striatula* and *Hypsiglena jani* (Werler and Dixon 2000, Holycross et al. 2002, Ernst and Ernst 2003, Mata-Silva et al. 2010). The predation on this snake suggests that *C. lepidus* can use other resources when its main prey is not available. Apparently *C. lepidus* was able to capture *L. mexicana* because become an easy target after recently feeding on a large lizard (*Sceloporus torquatus*) (Carbajal-Marquez et al. 2012). It has been reported that snakes after feeding display a reduction in activity and mobility and hence are more vulnerable to predation.

The percentage of birds ingested represented the 7.14% and is consistent with some reports (Holycross et al. 2002, Campbell and Lamar 2004). We found no arthropods, which differs with reports of several other authors, where they mentions the arthropods are prey of juveniles, primarily centipedes of the genus *Scolopendra* sp. *C. lepidus* can be considered generalist in relation to different types of prey found in the diet. But the high intake of lizards in the study area due to its location and activity patterns, high availability of lizards as they share similar microhabitats; just as habitat modification by the

construction of stone walls, which provides refuge to *C. lepidus* as the lizards, it makes *C. lepidus* has a specialized diet in lizards at Mesa Montoro.

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