NOTES ON THE DIET OF *CROTALUS INTERMEDIUS* TROSCHEL, 1865

NOTAS SOBRE LA DIETA DE *CROTALUS INTERMEDIUS* TROSCHEL, 1865

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Resumen.— En la literatura, solo se reportan cuatro presas específicas para la víbora cascabel enana (*Crotalus intermedius*) que ocurre en las sierras centrales y meridionales de México. Para aumentar estos datos, investigamos los contenidos estomacales de los especímenes de *C. intermedius* en la Colección de Herpetología del Museo de Historia Natural de la Universidad de Illinois (UIMNH). De los 23 especímenes examinados, siete contenían presas, todas las cuales eran lagartos del género *Sceloporus*. Como resultado, reportamos dos nuevas presas de la dieta conocida de *C. intermedius*. Además, nuestros datos, junto con la literatura publicada, sugieren que *Sceloporus* spp. son la fuente de alimento predominante de *C. intermedius*. Esta aparente especialización en la dieta puede hacer que *C. intermedius* sea más vulnerable, y por esta razón, mejorar el conocimiento de la historia natural será vital para informar los esfuerzos de conservación.

Palabras clave.— Alimentación, depredador-presa, ecología, historia natural, interacciones de especies, víbora cascabel enana.

Abstract.— Only four specific prey items are reported in the literature for the Mexican small-headed rattlesnake (*Crotalus intermedius*), which occurs in the central and southern Mexican highlands. To augment these data, we dissected museum specimens housed in the University of Illinois Museum of Natural History Herpetology Collection for stomach contents. Of the 23 specimens examined, seven contained prey, all of which were lizards of the genus *Sceloporus*. As a result, we report two novel prey items to the known dietary breadth of *C. intermedius*. Furthermore, our findings, in conjunction with published literature, suggest that *Sceloporus* spp. are the predominant food source of *C. intermedius*. This apparent diet specialization may make *C. intermedius* more vulnerable, and for this reason, improving natural history knowledge will be vital for informing conservation efforts.

Keywords.— Ecology, feeding, Mexican small-headed rattlesnake, natural history, predator-prey, species interactions.

The Mexican small-headed rattlesnake (*Crotalus intermedius*) is a small-sized rattlesnake endemic to the Mexican highlands, disjunctly occupying mixed pine-oak forests in the states of Hidalgo, Puebla, Tlaxcala, Veracruz, Oaxaca, and Guerrero (Heimes, 2016). However, at certain localities, it may inhabit cloud forests and deserts (SEMNAT, 2018). Currently, three subspecies are recognized: *C. i. intermedius*, which occurs in south-east Hidalgo, northern Puebla, Tlaxcala, and west-central Veracruz; *C. i. gloydi*, which occurs in central Oaxaca, and potentially, bordering areas of Puebla and Veracruz; and *C. i. omiltemanus*, which is restricted to the highlands of central Guerrero (Campbell and Lamar, 2004). There is little in terms of published literature on *C. intermedius* and many aspects of its natural history are poorly known.

Crotalus intermedius is thought to feed primarily on lizards of the genus *Sceloporus* and rarely rodents. However, few reported prey items have actually been identified to the specific level (Table 1). To acquire more unambiguous data on the diet of *C. intermedius*, we examined the stomach contents of *C. intermedius* specimens in the University of Illinois Museum of Natural History (UIMNH) Herpetology Collection (n = 23). Specimens were dissected via midventral incisions and prey items were extracted for identification. All prey items were lizards of the genus *Sceloporus* and identifiable remains were distinguished based on the squamation characteristics described by Smith (1936; 1939) and Smith and Bumzahem (1955) as well as direct comparisons with *Sceloporus* specimens in the UIMNH Herpetology Collection. As a result, we report two novel prey items for *C. i. gloydi*, one novel prey item for *C. i. intermedius*,

Tabla 1. Resúmen de los artículos de presa publicados para *Crotalus intermedius*. References: [1] Klauber (1972); [2] Campbell (1977); [3] Campbell & Armstrong (1979); [4] Campbell & Lamar (2004); [5] Bryson et al. (2006); [6] Canseco-Márquez & Gutierrez-Mayen (2010).

Table 1. Summary of published *Crotalus intermedius* prey items. References: [1] Klauber (1972); [2] Campbell (1977); [3] Campbell & Armstrong (1979); [4] Campbell & Lamar (2004); [5] Bryson et al. (2006); [6] Canseco-Márquez & Gutierrez-Mayen (2010).

Source	Subspecies	Prey Identity (Quantity)	State
[1]	*intermedius*	Unidentified lizards (2)	-
[6]	*intermedius*	Unidentified rodent (1)	Puebla
[5] ITAH 1331	*gloydi*	*Reithrodontomys fulvescens helvolus* (1)	Oaxaca
[3]	*gloydi*	Unidentified *Sceloporus* lizards (2+)	Oaxaca
[6]	*gloydi*	*Sceloporus bicanthalis* (1)	Oaxaca
[1]	*omiltemanus*	Unidentified lizards (12)	Guerrero
[2,3]	*omiltemanus*	lizards mostly of the genus *Sceloporus* (18)	Guerrero
[4]	*omiltemanus*	*Sceloporus formosus s.l.* [=*druckercolini*] (1+)	Guerrero
[1,4]	*omiltemanus*	*Sceloporus mucronatus s.l.* [=*omiltemanus*] (2+)	Guerrero

and ultimately, two total novel prey items for the *C. intermedius* species as a whole.

Six specimens of *C. i. gloydi* contained prey items, of which three were identified to the specific level (Table 2). UIMNH 52973 (collected October 1962 by T. MacDougall) contained one *Sceloporus grammicus* (Fig. 1), UIMNH 53099 (collected on 21 March 1963 by T. MacDougall) contained one *Sceloporus internasalis* (Fig. 2), and UIMNH 73616 (collected between July and December of 1965 by T. MacDougall) contained two *Sceloporus omiltemanus* (Fig. 3). Unassignable *Sceloporus* remains were present in the stomachs of UIMNH 60803, UIMNH 63688, and UIMNH 73617. Only one *C. i. intermedius* specimen, UIMNH 60804 (collected on 27 July 1964 by M. J. Landy and J. D. Lynch), contained stomach contents—*Sceloporus bicanthalis* (Fig. 4).

Indeed, our results support the notion that lizards, specifically those within the genus *Sceloporus*, are an important prey source for *C. intermedius*. Moreover, being saurophagous may translate to a greater dependency on lizard populations for future persistence, which may be troublesome amidst a changing climate (Sinervo et al., 2010). As of now, the conservation status of *C. intermedius* varies from source to source. According to the Secretaría del Medio Ambiente y Recursos Naturales

Tabla 2. Resúmen de los artículos de presa de Crotalus intermedius identificados en la Colección Herpetológica de la UIMNH.

Table 2. Summary of Crotalus intermedius prey items identified in the UIMNH Herpetology Collection.

Specimen	Subspecies	Sex	Prey Identity (Quantity)	Location	State	Snout-vent Length (mm)	Total Length (mm)	Direction of Ingestion
UIMNH 52973	*gloydi*	♀	*Sceloporus grammicus* (1)	Cerro San Felipe	Oaxaca	227	252	Head-first
UIMNH 53099	*gloydi*	♀	*Sceloporus internasalis* (1)	West of La Cumbre	Oaxaca	334	358	Head-first
UIMNH 60803	*gloydi*	♂	*Sceloporus* sp. (1)	Cerro San Felipe	Oaxaca	456	498	Head-first
UIMNH 60804	*intermedius*	♂	*Sceloporus bicanthalis* (1)	Cofre de Perote	Veracruz	361	394	Head-first
UIMNH 63688	*gloydi*	♂	*Sceloporus* sp. (1)	Cerro San Felipe	Oaxaca	305	341	Head-first
UIMNH 73616	*gloydi*	♀	*Sceloporus omiltemanus* (2)	Cerro San Felipe	Oaxaca	406	443	Head-first
UIMNH 73617	*gloydi*	♂	*Sceloporus* sp. (1)	Cerro San Felipe	Oaxaca	236	259	Head-first

Figura 1. Vista dorsal de *Crotalus intermedius gloydi* (UIMNH 52973) y la presa (*Sceloporus grammicus*) extraída de su estómago.

Figure 1. Dorsal view of *Crotalus intermedius gloydi* (UIMNH 52973) and the prey item (*Sceloporus grammicus*) removed from its stomach.

Figura 2. Vista dorsal de *Crotalus intermedius gloydi* (UIMNH 53099) y la presa (*Sceloporus internasalis*) extraída de su estómago.

Figure 2. Dorsal view of *Crotalus intermedius gloydi* (UIMNH 53099) and the prey item (*Sceloporus internasalis*) removed from its stomach.

Figura 3. Vista dorsal de *Crotalus intermedius gloydi* (UIMNH 73616) y la presa (*Sceloporus omiltemanus*) extraída de su estómago.

Figure 3. Dorsal view of *Crotalus intermedius gloydi* (UIMNH 73616) and the prey item (*Sceloporus omiltemanus*) removed from its stomach.

Figura 4. Vista dorsal de *Crotalus intermedius intermedius* (UIMNH 60804) y la presa (*Sceloporus bicanthalis*) extraída de su estómago.

Figure 4. Dorsal view of *Crotalus intermedius intermedius* (UIMNH 60804) and the prey item (*Sceloporus bicanthalis*) removed from its stomach.

(SEMARNAT, 2018), the status of *C. intermedius* is considered 'Least Concern' (LC) by the IUCN, 'Amenazada' (A)—Threatened—by SEMARNAT, and 'Peligro de Extinción' (P)—Endangered—by Jiménez-Velázquez et al. (2018). *C. intermedius* is also placed in the 'high vulnerability' category of Environmental Vulnerability Scores (EVS) (e.g., Mata-Silva et al., 2015). Similarly, all of the recorded *Sceloporus* in the diet of *C. intermedius* are within the middle or high vulnerability categories of EVS except for *S. grammicus* (Mata-Silva et al., 2015; Palacios-Aguilar & Flores-Villela, 2018).

Moreover, *C. intermedius* also appears to have low fecundity (Armstrong & Murphy, 1979; Canseco-Marquez & Gutierrez-Mayen, 2010; Kalki et al., 2019), so improving natural history knowledge for this species will be vital for informing conservation management and warranting protection. Future studies will likely add to the list of prey items for *C. intermedius* and, perhaps, provide some clarity regarding its conservation status as well as the circumstances under which it consumes non-lizard prey. This study encourages the use of natural history collections to obtain invaluable natural history data for poorly known species, which will form the underpinnings of future conservation efforts.

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