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Short Communication

New prey items of *Crotalus campbelli* (Serpentes: Viperidae) from Mexico

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Palavras-chave: Cascavel-escura-de-campbell, Coleoptera, Dieta, *Sceloporus bulleri*, *Sceloporus unicanthalis*, *Stenopelmatus*.

Campbell´s Dusky Rattlesnake (*Crotalus campbelli* Bryson Jr., Linkem, Dorcas, Lathrop, Jones, Alvarado-Díaz, Grünwald, and Murphy, 2014) is a small montane rattlesnake that is part of the *Crotalus triseriatus* group (Bryson *et al.* 2014). *Crotalus campbelli* is endemic to western Mexico and occurs in the states of Colima and Jalisco, inhabiting rocky open areas within pine-oak and cloud forests (Bryson *et al.* 2014, Heimes 2016). The species is not included in the NOM-059-SEMARNAT-2010; thus, it does not receive protection by the Mexican government (SEMARNAT 2010) and is not considered by the IUCN Red List of Threatened Species, it is Highly Vulnerable according to its Environmental Vulnerability Score of 17 (see Johnson *et al.* 2017). Information about its natural history is scarce, and only one unidentified rodent has been reported as part of its diet under the synonym of *Crotalus triseriatus* (Wagler, 1830) (Mociño-Deloya *et al.* 2014). Here we report new prey items from specimens collected during field surveys.

We conducted field surveys in 2019–2020 in thigh elevations of Sierra de Manantlán, Colima, Mexico (19.395085° N, 103.896438° W; WGS84; 2200 m a.s.l.) in order to locate individuals of this species. The habitat is characterized by the presence of pine-oak forest with outcrops of karst rock (Padilla-Velarde *et al.* 2006). We found four *C. campbelli.* One adult male was found during a predation event while consuming a lizard and was not disturbed or captured. Two specimens, a juvenile female and a newborn male, were captured alive, handled with tongs and herpetological tubes and gently palpated in

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search of stomach contents or scats. The juvenile female was released in the same place of capture, and the newborn male was euthanized by injecting sodium pentobarbital, 60–100 mg/kg intracelomically. One newborn female was found dead, and a mid-ventral incision was made to determine the presence of food remains in the gut. We measured the snout–vent length (SVL; ± 1 mm) and tail length (TL; ± 1 mm) with a measuring tape, determined sex by cloacal probing or by everting the hemipenes, and recorded date, locality, number, and identity of prey items. We calculated the weight ratio (WR) by dividing the mass of the prey by the mass of the snake. The collected snakes were fixed with 10% formalin, and then housed, along with their prey remains, in individual containers with 70% ethanol. Scats were deposited in 70% ethanol and both specimens and scats were deposited in the herpetological collection of the Universidad Autónoma de Aguascalientes (UAA-REP). Dorsal scales of lizard prey were compared with scales of lizards from UAA-REP that were from the same locality where the rattlesnakes were found. Arthropods were identified based on the characters of the remains found; for Jerusalem crickets, we followed Weissman *et al.* (2021). The known distribution of prey species was also used as a criterion for species-level identification. The data reported for both the snakes and their prey follow Maritz *et al.* (2021).

The four specimens of *Crotalus campbelli* from field surveys were examined. An adult male *C. campbelli* ca. 400 mm in total length was found on 31 July 2004 at 10:00 h while consuming an adult female *Sceloporus bulleri* Boulenger, 1895 (Buller's Spiny Lizard) headfirst, with the tail apparently freshly autotomized (Figure 1). No additional data were collected in order to avoid interrupting the predation event. The sex of the rattlesnake was determined based on the relatively lighter coloration and longer tail; the sex of the lizard was determined by the absence of enlarged post-anal scales and the absence of blue coloration on the abdomen and thighs (vs. present in males). We identified the lizard as *S. bulleri* because only this species of the *Sceloporus torquatus* group occurs in the area (Reyes-Velasco *et al.* 2020). We estimated the weight of the male *C. campbelli* to be approximately 45 g based on a specimen of similar size of the closely related *Crotalus pusillus* Klauber, 1952 (UAA-REP 875). The female *S. bulleri* was at least 95 mm in SVL and 70 in TL, with an estimated weight of 35 g based on a female *S. bulleri* of similar size (UAA-REP 835). These weight estimates yielded a WR of at least 0.78.

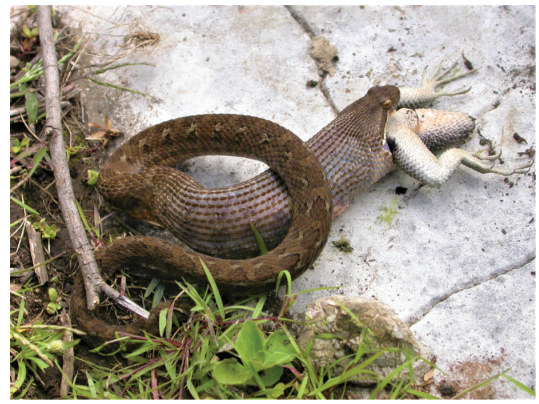

Figure 1. A female lizard *Sceloporus bulleri* being preyed upon by an adult male *Crotalus campbelli,* found in an open area with karst outcrops in pine-oak forest in the Sierra de Manantlán, Colima, Mexico. Photo: JMJ.

Another juvenile female *C. campbelli* was found on 07 July 2019 (UAA-REP 831). The snake measured 353 mm in SVL and 34 mm in TL. The scat contained scales belonging to *Sceloporus unicanthalis* Smith, 1937 (South-western Bunchgrass Lizard), the only species of the *Sceloporus scalaris* group that occurs in the area (Reyes-Velasco *et al.* 2020). The snake was released at point of capture and only the scat was collected. On 26 September 2020 two additional specimens of *C. campbelli* were found at the same locality: a newborn female (UAA-REP 778; 171 mm SVL, 15 mm TL) was found dead at 14:20 h, probably killed by local people. After

dissection, we found a *Stenopelmatus faulkneri* Weissman, 2021 (Faulkner's Jerusalem cricket) partially digested in the intestines and ingested headfirst. The second specimen was a newborn male (UAA-REP 830; 171 mm SVL, 16 mm TL) found under a log at 13:10 h. Following palpation, a scat was obtained that contained the partially digested remains of an unidentified coleopteran larva.

These are the first reported records of consumption of *Sceloporus bulleri, Sceloporus unicanthalis, Stenopelmatus faulkneri,* and coleopteran larvae by *Crotalus campbelli.* In addition, *S. faulkneri* represents a new state record for Colima (see Weissman *et al.* 2021). The new prey of *C. campbelli* reported here, along with the unidentified rodent reported by Mociño-Deloya *et al.* (2014), are the only known prey. These results indicate that adults of *C. campbelli* feed on lizards and small mammals, while juveniles may also consume arthropods. Other closely related species [*Crotalus aquilus* Klauber, 1952, *Crotalus lepidus* (Kennicott, 1861), *Crotalus ravus* Cope, 1865, and *Crotalus triseriatus*] are known to consume vertebrates such as lizards (mainly *Sceloporus* spp.) and small mammals as adults, and arthropods as juveniles (Klauber 1972, Holycross *et al.* 2002, Mendoza-Hernández *et al.* 2004, Güizado-Rodríguez *et al.* 2016, Mociño-Deloya 2016).

The ingestion of crickets (Orthoptera) by rattlesnakes has been documented in *Crotalus aquilus, Crotalus pusillus* (Armstrong and Murphy 1979), *Crotalus ravus* (Sánchez-Herrera 1980), and *Sistrurus miliarius* (Linnaeus, 1766) (Mitchell 1903); some may have been *Stenopelmatus.* Specific reports of rattlesnakes consuming *Stenopelmatus* spp. include *C. ravus* (Campbell and Armstrong 1979), and *C. triseriatus* (Klauber 1972). The presence of arthropods in the gut of rattlesnakes has typically been regarded as secondary ingestion because the gut contents also contained vertebrate remains (Holycross *et al.* 2002, Mociño-Deloya 2016). However, because the arthropods were consumed by newborn *C. campbelli* in this study, it is confirmed that they were prey items, not secondary ingestion.

The WR estimated for the adult male *C. campbelli* and its *S. bulleri* prey is fairly high, which may induce significant costs such as long handling and processing time, vulnerability to predators, or even mortality (Avila-Villegas *et al.* 2005, Loughran *et al.* 2013). However, the energetic benefits of a large prey may outweigh the cost of subduing and ingesting it. The high WR found in this study is consistent with an emerging pattern for vipers. It is well known that vipers occasionally eat large prey with a high WR, even higher than WR = 1.0 (Greene 1983, 1992, Loughran *et al.* 2013).

We recommend continuing to document the diet of this and other poorly studied pitvipers (prey preference, ontogenetic change, sexual differences, and seasonal changes in diet) to obtain a better understanding of their natural history. Additionally, these data may help generate better conservation strategies for species of pitvipers.

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