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Diet of the Baja California Rattlesnake, *Crotalus enyo* (Viperidae)

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The Baja California rattlesnake, *Crotalus enyo*, is a medium-sized rattlesnake restricted to the southern two-thirds of the Baja California peninsula. Very little is known about the natural history of this species. The goal of this study was to document the diet of *C. enyo*. I dissected the stomachs and hindguts of 113 preserved museum specimens of *C. enyo* and identified the ingested prey items. The diet of *C. enyo* consists of small rodents, lizards, and centipedes. *Crotalus enyo* of all sizes eat rodents and lizards, in contrast to many other rattlesnakes that eat almost exclusively lizards as juveniles and mammals as adults. However, *C. enyo* exhibits a modest ontogenetic shift in diet: small snakes eat lizards more often than do large snakes, and large snakes eat mammals more often than do small snakes. Adult *C. enyo* also eat large centipedes of the genus *Scolopendra*. Larger snakes tended to contain multiple prey items more often than smaller snakes, but this trend was not significant. *Crotalus enyo* is sexually dimorphic in size, with males being significantly larger than females. However, there is no significant gender difference in diet.

DATA on the diet of a species can help to evaluate and understand its reproductive strategies (Shine and Madsen, 1997) and habitat use and distribution patterns (Klauber, 1972), construct conservation regimes (Greene, 1994), and comprehend evolutionary divergence in feeding ecology between animals and their relatives (Greene, 1993; Rodríguez-Robles et al., 1999). The Baja California rattlesnake, *Crotalus enyo*, is a medium-sized snake, with a maximum known total length of 898 mm (Beaman and Grismer, 1994). It ranges throughout most of the Baja California peninsula, from Cabo Colonet in Baja California Norte southward to the tip of the peninsula (Lowe and Norris, 1954; Beaman and Grismer, 1994), including many islands off the Pacific and Gulf of California coasts (Beaman and Grismer, 1994). Typical habitats are rocky with low scrub vegetation and brush, often near human habitations (Van Denburgh and Slevin, 1921; Lowe and Norris, 1954; Klauber, 1972). Little is known of the diet of *C. enyo*, although it is believed to eat small mammals (Van Denburgh and Slevin, 1921; Klauber, 1931, 1972). In this study, my goal was to examine in detail the dietary habits of *C. enyo* by identifying prey from the digestive tracts of preserved museum specimens.

MATERIALS AND METHODS

I examined 113 museum specimens of *C. enyo* (see Material Examined; institutional abbreviations are as listed in Leviton et al., 1985). I checked for stomach and hindgut contents by making ventral incisions. For each snake with prey, I recorded locality, date of collection, body size (snout–vent length, SVL ± 0.1 mm), and body mass (± 0.1 g). Each specimen was blotted on a paper towel to remove excess ethanol before obtaining body mass. I recorded the number, location (stomach or hindgut), direction of ingestion (head-first, tail-first, or sideways), and whenever possible identification of prey items. When only scales or hairs were present in the digestive tracts, the prey items were identified as ''lizards'' or mammals, respectively (except in the case of *Chaetodipus* sp., where positive identification to genus could be made because of the unique pale color and thick, coarse quality of the hairs).

RESULTS AND DISCUSSION

Of the 113 *C. enyo* examined, 63 (55.8%) contained 78 at least partly identifiable prey in their stomachs and/or hindguts, and six snakes contained unidentifiable prey. Twenty-one snakes contained prey in their stomachs, 35 contained prey in their hindguts, and 13 contained prey in both their stomachs and hindguts. Of the 63 snakes with identifiable prey, 45 (71.4%) contained mammals (*Chaetodipus, Dipodomys, Peromyscus,* and *Thomomys*), 26 (41.3%) contained lizards (*Cnemidophorus, Dipsosaurus, Sceloporus,* and *Uta*), and 4 (6.3%) contained centipedes (*Scolopendra*; Table 1). The high frequency of unidentified mammals and lizards is a result of most of prey being highly digested items found in the hindgut region. The relatively high occurrence of *Chaetodipus* sp. is probably a result of the ease of identifying this genus compared to other rodent prey genera.

Crotalus enyo of all body sizes feed on lizards,

TABLE 1. PREY EATEN BY *Crotalus enyo*.

Prey taxon	Number of *C. enyo* with prey type
CHILOPODA	
Scolopendromorpha	
Scolopendridae	
Scolopendra sp.	4
MAMMALIA	
Rodentia	
Geomyidae	
Thomomys bottae	1
Heteromyidae	
Chaetodipus spinatus	3
Chaetodipus sp.	14
Dipodomys sp.	1
Muridae	
Peromyscus sp.	1
Unidentified mammal	25
REPTILIA	
Squamata	
Iguanidae	
Dipsosaurus dorsalis	2
Phrynosomatidae	
Sceloporus sp.	1
Uta stansburiana	1
Teiidae	
Cnemidophorus sp.	3
Unidentified lizard	19
Unidentified animal	6

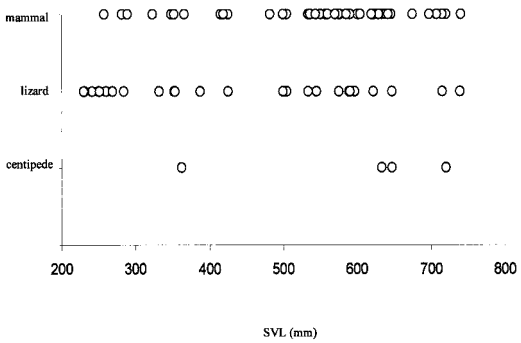

Fig. 1. *Crotalus enyo* snout–vent length (SVL) versus prey type. Snakes of all sizes ate mammals and lizards. However, note that larger snakes ate more mammals than lizards, and smaller snakes ate more lizards than mammals. Centipedes were eaten primarily by large snakes.

mammals and centipedes. However, there were significant differences in SVL between snakes that ate each of the major prey taxa (Kruskal-Wallis test, $H = 11.49$, df = 2, $P = 0.003$; Fig. 1). Snakes that fed on lizards were smaller (SVL = 422.3 ± 167.2 mm, range 230–740 mm, $n = 26$) than those that fed on mammals (SVL = 550.4 ± 127.2 mm, range 258–741 mm, $n = 45$; unpaired *t*-test, df = 67, $P = 0.0007$) and those that fed on centipedes (SVL = 591.0 ± 135.8 mm, range 363–720 mm, $n = 4$; unpaired *t*-test, df = 27, $P = 0.045$). There was no significant difference in SVL between snakes that fed on mammals and those that ate centipedes (unpaired *t*-test, df = 48, $P = 0.50$). The ontogenetic shift in the diet of *C. enyo* from a preference for lizards as juveniles to mammals as adults is a pattern seen in many rattlesnakes (Klauber, 1972). Also, centipede prey is not unique to *C. enyo*. Other species of rattlesnake that eat centipedes are the massasauga, *Sistrurus catenatus* (Lardie, 1976), pigmy rattlesnake, *Sistrurus miliarius* (Hamilton and Pollack, 1955; Klauber, 1972), rock rattlesnake, *Crotalus lepidus* (H. Greene, pers. comm.), Mojave rattlesnake, *Crotalus scutulatus* (Klauber, 1972), and ridge-nosed rattlesnake, *Crotalus willardi* (Fowlie, 1965; A. Holycross, pers. comm.).

Of the 78 prey items identified, 47 (60.3%) were mammals, 26 (33.3%) were lizards, and five (6.4%) were centipedes. Fifty of 63 (79.4%) *C. enyo* with prey contained a single prey item. One *C. enyo* contained one centipede and one lizard, two contained one centipede and one mammal, one contained two centipedes and one mammal, seven contained one lizard and one mammal, and two contained two mammals. Although not significant, there was a trend for snakes with multiple prey (SVL = 579.8 ± 116.8, range 352–741 mm, $n = 13$) to be larger than snakes with single prey (SVL = 481.5 ± 161.6, range 230–740 mm, $n = 50$; Mann-Whitney *U*-test, $Z = -1.83$, $P = 0.08$). These data may be confounded by the possibility that same-type multiple prey instances were overlooked. Prey were only designated as multiple items if there was more than one prey type present (e.g., mammal hairs and lizard scales) or if there was obvious evidence of more than one individual of the same prey type (e.g., two whole mammals).

Relationships between snake size and mass and prey size and mass could not be established in most cases because prey usually consisted only of highly digested fragments. However, several snakes had freshly ingested prey. One male snake (MVZ 190042, 215.4 g, SVL 634 mm) contained a 6.7 g, 170 mm centipede (*Scolopendra* sp.) swallowed sideways, as well as a *Chaetodipus* sp. in its stomach and remnants of another centipede in its hindgut. Another male snake (CAS 204092, 144.5 g, SVL 642 mm) contained at least two nestling gophers (*Thomomys bottae*), both consumed head-first, one of which was still

whole (8.5 g, 63.9 mm). In conclusion, from the limited prey items that could be identified, it appears that *C. enyo* predominantly eats small rodents, lizards, and centipedes.

As is the case in most rattlesnakes (Klauber, 1972), adult males of *C. enyo* were significantly larger than females (males: SVL = 554.23 ± 142.32, range 230–741 mm, $n = 57$; females: SVL = 485.23 ± 143.26, range 241–708 mm, $n = 39$; Mann-Whitney *U*-test, $Z = -2.33$, $P = 0.02$). Many snakes with sexual size dimorphism exhibit gender-specific prey differences (Houston and Shine, 1993; Shine et al., 1998). For *C. enyo*, such a difference was not significant ($\chi^2 = 4.85$, df = 2, $P = 0.09$).

Material Examined

Crotalus enyo: CAS 14022, 15629–30, 15633, 18858, 45879–80, 45882–86, 87372, 101612, 103469, 110997, 134798, 135229, 140939, 140941, 142411, 143844, 143853, 143965, 143982, 143987, 146576, 146748, 147693, 152417, 152448, 160229, 204088–92, 204094; KU 78969, 185659; LACM 2966, 20022–23, 25081–82, 74024, 74030, 104860, 107220–21, 107223, 121553, 126267–68, 132134–36, 134437–38; MVZ 11919–22, 13795, 50179, 54636–37, 73623, 117450, 164980, 176060–64, 182137–39, 182168, 182250, 182272–74, 189960, 189962–63, 189967–68, 189970–72, 189998, 190000, 190038, 190042–43, 190063, 190086–87, 190128–29; UAZ 23294–95, 23521, 31692–93; USNM 12623, 23724, 240245, 240362–63, 240690.

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