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Food Habits in Oklahoma *Crotalus atrox* in Fall and Early Spring

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The food preferences of *Crotalus atrox* have received considerable attention in the literature (Klauber, 1956; Beavers, 1976; Loughry, 1987; Reynolds and Scott, 1982). Preferences is perhaps an inappropriate term, as this species has a wide range of acceptable prey, and additionally may not bypass carrion (Gillingham and Baker, 1981).

A study of western diamondback rattlesnakes, *Crotalus atrox,* collected in spring of 1987 and 1988 during Oklahoma's rattlesnake roundups presented an opportunity to examine food habits of this species from three localities: Waurika (Jefferson Co.), Waynoka (Major Co.), and Okeene (Blaine Co.). The data were accumulated during an investigation of the probable impact of these hunts on snake habitat and populations.

METHODS

Snakes sampled were collected within a 30-mile radius of each locality by area residents two weeks prior to the public event (at which time snakes may be brought from varied localities). There is a certain amount of transfer of snakes from earlier roundups to later ones, but these snakes were kept segregated from local ones by event sponsors and were not included in our samples. In 1988, viscera from 347 snakes (143 female, 204 male) were collected immediately as snakes were killed, and were preserved at once by submerging in 10% formalin. Viscera were identified to previously weighed and measured (several parameters) snakes by recovery of a numbered plastic tag inserted deeply into the esophagus of each live snake examined. In 1987, viscera from 60 (22:38, m:f) representative Waynoka snakes were similarly collected, but were not tag-referenced to individual living snakes. After formalin-fixation of several days, viscera were soaked for 24 hours in water, then transferred to 70% ethanol for storage.

Viscera were examined during summers of 1987 and 1988. Detailed analyses of reproductive data, fat-body weights, parasites and pathologies are presented in manuscripts in preparation. G-I tracts were slit lengthwise from the esophagus to the rectum, and macroscopically examined for visible parasites, other pathologies, food, and fangs. Samples for microscopic examination were collected and transferred to vials. Food remains were observed in 81 viscera (22.8%); shed fangs were recovered from 36 (10.1%). In all but

Table 1. Mammalian prey.

Species	Snakes found in	% total freq.
Neotoma floridana and/or *Peromyscus* (*maniculatus* and/or *l. leucopus*)	16	20.0%
Rattus norvegicus	12	15.0%
Perognathus hispidus/flavus or *Mus* sp.	10	12.5%
Sylvilagus floridanus	6	7.5%
Perognathus flavescens	6	7.5%
Microtus ochrogaster	5	6.3%
Sigmodon hispidus	5	6.3%
Reithrodontomys megalotus	4	5.0%
Spermophilus spilosoma	3	3.8%
Cynomys ludovicianus	3	3.8%
Geomys bursarius	3	3.8%
Sciurus niger rufescens	2	2.5%
Dipodomys ordii	2	2.5%
Cratogeomys castanops	1	1.3%
Lepus californicus	1	1.3%
Unident. mole species	1	1.3%
Total		100.4%

one specimen (in which avian prey remains were recovered from the stomach), prey remains were found in the large intestine and/or rectum.

Prey remains, primarily hair samples, were identified by comparison with a photo atlas prepared for that purpose, a technique employed by Reynolds and Scott (1982). Hair samples from potential prey species found sympatric with the snakes were obtained from the Mammalogy Division, University of Kansas Museum of Natural History. Samples for *Rattus norvegicus* and *Mus musculus* were obtained locally. Hair samples were photographed (wet mounts in 70% ethanol) at 100× or 160× magnification with Kodacolor-200 film and a Zeiss "Standard-17" microscope with Contax RTS camera. Photos were printed to 86 mm × 125 mm size; samples from snake G-I tracts were then prepared as wet mounts in 70% ethanol and projected to convenient viewing size using a Bausch and Lomb Model ER carbon arc microprojector. Results are summarized in Table 1. Guard hairs of certain species were difficult to distinguish, and in these instances the observations were pooled.

Specimens presently are maintained in the University of Kansas Biology Teaching Collection.

Results

Crotalus atrox is widely distributed, and has been recorded to feed upon a wide variety of prey. Klauber (1956:190) recorded the following diet items from localities given parenthetically: fox squirrel (TX, AZ); *Sylvilagus* ssp.

(TX, AZ, OK); quail (AZ, OK); *Perognathus* several sp. (TX, AZ); ground squirrel (AZ); *Peromyscus* spp. (TX); *Onychomys* sp. (AZ); *Cryptotis parva* (TX); *Neotoma albigula* (TX); burrowing owl (?); unident. birds (?); *Cnemidophorus* (Mexico); *Sceloporus* (TX); *Coleonyx* (TX); lubber grasshoppers (TX).

Klauber (1956) also noted that the less widespread Eastern diamondback (*Crotalus adamanteus*) has been reported to eat small mammals and a variety of birds, including quail, woodpeckers, towhee, and a young wild turkey.

Waurika (24–25 March 1988). The stomach of one snake, a female (#69; 1197 mm total length, exclusive of rattle; 1150 g live weight), captured by a group of Oklahoma hunters who collected from dens along the Red River in the vicinity of Oscar (OK: Jefferson Co., 10 miles ESE jct. State Rte. 32 and US Hwy. 81), contained feathers identifiable as those of an adult Eastern Meadowlark. The feathers were in a collapsed mass, arranged [we assume] approximately as on the bird when it was swallowed. The snake was collected between 21 and 24 March 1988. Weather in the area was generally cool enough to restrict daily activity of the snakes to daylight hours in the immediate den areas; the only roads in the vicinity of the dens are lightly travelled, sand surfaced township roads. Habitat is within the Oak-Woodland Faunal Region as discussed by Webb (1970), and consists of sparsely wooded rangeland, interspersed with wooded and brushy areas along bluffs of the Red River and its tributaries.

Birds are uncommon, but not unusual, in the diet of *Crotalus atrox*, and have been reported by Best and James (1984, *Amphispiza* and *Eremophila*), Beavers (1976, *Pipilio, Melospiza*, other genera), King (1975, *Larus*), and others in addition to Klauber (ibid.).

A total number of 137 viscera were examined from this locality (78:59, m:f). Twenty viscera (14.6%) contained food remains. Fangs were recovered from 19 (13.8%).

Okeene (14–15 April 1988). A total of 105 viscera from Okeene snakes were examined (63:42, m:f). Twenty-eight viscera (26.7%) contained food remains. Fangs were recovered from two viscera (2%). All food remains from this locality and Waynoka were mammalian. Although this area and the next are within the Grassland Faunal Region as discussed by Webb (1970), Webb points out that actual habitat types vary considerably from sparsely wooded grassland and rangeland, through densely wooded and brushy areas. The habitat of *Crotalus atrox* also includes some areas of stabilized sand dunes. Along bluffs of the North Canadian and Cimarron rivers and their tributaries are numerous gypsum and sandstone outcrops.

Waynoka (8–9 April 1988). A total of 92 viscera were examined in 1988 (78:59, m:f); 60 were examined in 1987 (38:22, m:f). Thirty-two viscera (21.1%) contained food remains. Fangs were recovered from 10 (6.6%).

Discussion

Viscera samples from 19.7% of 407 specimens of *Crotalus atrox* examined in spring of 1987 and of 1988 contained identifiable food remains (primarily in the rectum). It was not possible to say with certainty what percent of these represent late feeding the previous fall versus feeding in the year of collection. There was no difference in prey type by locality. There is an interesting temporal trend in percent of snakes with food remains in the gut; 14.6% in Waurika (farthest south and earliest date), 21.1% in Waynoka, and 26.7% in Okeene (latest date of the series). This sequence is not unexpected, given that Okeene snakes likely had a somewhat longer time to feed, despite the slightly delayed onset of warm weather in northern counties. However, as this report primarily involves only one season's data, we feel additional work should be done before this conclusion is given much weight.

Additionally, two of these hunts did not accept small snakes and had discontinued their "smallest snake caught" award. These facts, coupled with the fact that only adult snakes are killed at these hunts, means our sample included no data from juveniles. This may explain the absence of several smaller prey types (especially lizards) reported by others. Several juvenile snakes were brought in by local collectors, and were measured and weighed by us. However, small snakes were to be released, and we did not wish to discourage this by killing them for hind-gut samples or risking injury to them by attempted flushing.

Crotalus atrox has a rather generalized diet, and is able to utilize a wide variety of prey species throughout its range. Reynolds and Scott (1982) indicated a high correlation between percent frequency of a prey species in the diet of *Crotalus atrox* and the availability of that species in the habitat. Practically all of the over 800 snakes examined during this study were in excellent health, with a high incidence of female reproductive ripeness and abundant body fat in both sexes.

Various methods of estimating prey importance in snake diets have been used (Beavers, 1976). Each has its particular disadvantages, and that coupled here with the fact that most prey were thoroughly digested prompts us to present our findings as percent of total frequency of those snakes containing prey remains. Because prey sizes are unknown, no attempt has been made to speculate on the relationships between prey and predator sizes. An additional caveat is that only the most enzyme-resistant prey remains would be found in the rectum. Thus, it is possible that reptile prey and certain other potential prey organisms would be overlooked in our results because remains were totally dissociated.

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Literature Cited

Beavers, R. A. 1976. Food habits of the western diamondback rattlesnake, *Crotalus atrox*, in Texas. Southwestern Nat. 20(4):503–515.

Best, T. L., and H. C. James. 1984. Rattlesnakes (genus *Crotalus*) of the Pedro Armendariz lava field, New Mexico. Copeia 1984(1):213–215.

Gillingham, J. C., and R. E. Baker. 1981. Evidence for scavenging behavior in the western diamondback rattlesnake (*Crotalus atrox*). Zeitschrift Tierpsychol. 55(3):217–227.

King, K. A. 1975. Unusual food item of the western diamondback rattlesnake (*Crotalus atrox*). Southwestern Nat. 20(3):416–417.

Klauber, L. M. 1956. Rattlesnakes: Their Habits, Life Histories and Influence on Mankind. Univ. of California Press, Berkeley.

Loughry, W. J. 1987. Differences in experimental and natural encounters of black-tail prairie dogs with snakes. Animal Behav. 35(5):1568–1570.

Reynolds, R. P., and N. J. Scott. 1982. Use of a mammalian resource by a Chihuahuan snake community. Pages 99–118 *in* N. J. Scott, Jr. (ed.), Herpetological Communities: A Symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologists' League, August 1977. U.S. Fish and Wildl. Svce., Wildl. Res. Rep. 13.

Webb, R. G. 1970. Reptiles of Oklahoma. Univ. of Oklahoma Press. xi + 370 pp.