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NATURAL HISTORY OF THE MILK SNAKE (*LAMPROPELTIS TRIANGULUM*) IN NORTHEASTERN KANSAS

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ABSTRACT: Over a 22-year period 151 live milk snakes, *Lampropeltis triangulum sypila*, from Douglas County, Kansas, or nearby areas were examined. Adult males average 6% larger than females. Length of tail is not significantly different in the sexes. Recaptured marked snakes moved 250–1300 ($\bar{x} = 832.5$) ft, indicating home ranges of about 50 acres. Ten females had 5–9 ($\bar{x} = 6.7 \pm .46$) eggs—a relatively small clutch compared with the 13 calculated for *L. t. triangulum* of the eastern United States. However, *L. t. triangulum* attains much larger size. Hatchling *sypila* are about 200 mm SVL. By the following spring, young average 240 mm, and by the second spring, 360 mm. By the third spring, most are 400–500 mm and some are sexually mature; growth rate is not much reduced in the fourth and fifth years. Among 22 natural food items, *Eumeces fasciatus* is by far the most frequent, with *E. obsoleta*, *Diadophis punctatus*, *Carphophis vermis*, *Cryptotis parva*, and *Peromyscus maniculatus* making up the remainder.

THE milk snake is a polytypic species ranging from Ontario in southern Canada through much of the United States, Mexico and Central America into northern South America (Peters and Orejas-Miranda, 1970). It is notable for geographic variation resulting from exposure to widely divergent climates, habitats, kinds of prey, and natural enemies, and it has more recognized subspecies (15) than any other American snake.

Obviously, the ecological niche of such a species changes geographically. Ecological interrelationships that are critical in one area may not exist elsewhere in the range. Changes in physical tolerances and in biotic interactions are of exceptional interest but as yet are little known in the milk snake.

Our purpose was to study the habits and ecology of *L. triangulum* in one local area. In the region of our study, the milk snake is less common than most other local snakes, and its secretive habits render it difficult to find. Data were assembled over a 22-year period. Only 151 live milk snakes were examined and information is still remarkably scanty or lacking concerning certain aspects of the natural history.

MATERIALS AND METHODS

Many of the records in this report were obtained on the University of Kansas Natural History Reservation where Fitch has carried on field work since July 1948. Milk snakes found on this 590-acre area were routinely measured, weighed, scale-clipped according to the Blanchard and Finster (1933) method and released, generally at the point of capture. From time to time collecting trips were made to other areas, usually within a 20-mile radius of Lawrence, Kansas, and milk snakes were taken along with various other kinds of reptiles. After desired information was obtained, some of these specimens were preserved, some were donated to collections of live reptiles, and some were released at the place of capture or at a new location in seemingly suitable habitat. In the early 1960s Fleet contributed a substantial number of specimens, and in 1966, 1967, and 1968 a concentrated collecting effort resulted in 41 milk snakes. Many of these were marked and released in a favorable area, but none were recovered except after short intervals.

DESCRIPTION

The population of milk snakes studied is highly variable in lepidosis, color and pattern. Part of the variability can be attributed to the fact that the zone of intergradation between *L. t. sypila* and *L. t. gentilis* lies just west of our study area. The snakes that we examined were predominantly *sypila* in their characters, but some would have passed as *gentilis* or even *triangulum* if their provenance had not been known.

Little attention was devoted to lepidosis in our study. Nine snakes had a modal number of 21 (18–22) body scale rows anteriorly, 21 (20–22) at midbody, and 18 (17–19) posteriorly. Ventrals averaged 203.2 (195–210) in 7 males and 208.0 (205–211) in 2 females; subcaudals averaged 47.3 (40–54) in males and 38.5 (35–42) in females.

In 35 snakes, white bands on the body and tail averaged 31.3 (25–40), red bands averaged 30.2 (22–35) and black bands averaged 52.7 (48–74). Since the black bands border and separate the other two colors, there are typically twice as many black bands as there are red; the series begins with a white band on the neck. However, there are many irregularities, especially on the tail. Some bands are fused, represented by only small spots, or absent.

The red bands were generally coral-colored. Their brightness varied somewhat according to the stage of molt and the age of the snake, but there was much individual genetic variation. In one adult female the bands were gray, so that the appearance matched that of *L. t. triangulum*. All others were red, but in a few it was relatively dull and suffused with gray.

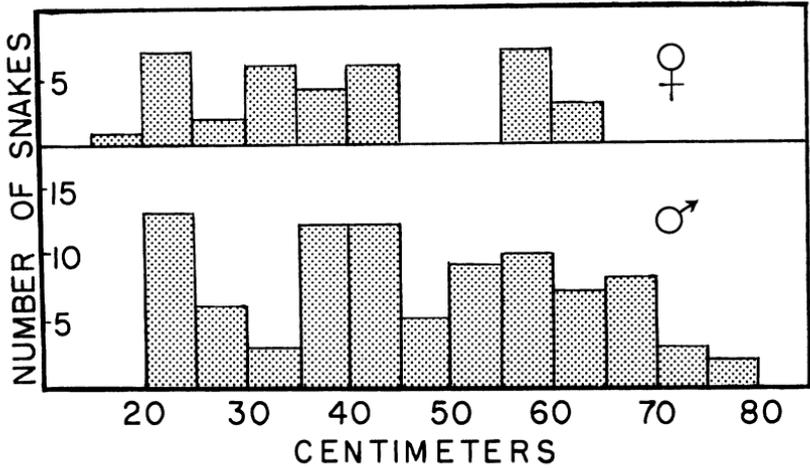


FIG. 1.—Snout-vent lengths of milk snakes, *Lampropeltis triangulum sypila*, in Douglas County, Kansas, and adjoining areas.

Seven males were larger than any female. The largest one-quarter of the male group averaged 66.2 (59.6–79.7) cm SVL and was 6% larger than the corresponding female group which averaged 62.4 (58.2–67.2) cm. Fig. 1 shows that the first-year and second-year snakes of each sex are distinct from older and younger groups, that beyond the second year, young do not form a size group distinct from adults, and that in each age class males are somewhat larger than females. Fig. 2 shows weight histograms of both sexes. Adults usually weigh more than 40 g; the heaviest was a male which weighed 110 g.

Male snakes generally have relatively longer tails than females (Klauber, 1943). However, in 64 males the tail length averaged 14.8% of snout-vent length and was not significantly different from the 14.5% of 49 females. Most snakes show ontogenetic trends in relative tail length (Klauber, 1943; Fitch, 1960). In 23 adult (over 500 mm SVL) males, tail length averaged 14.4% of body length, whereas in 41 young (less than 500 mm) males, tail length averaged 15.0% of body length. For 27 adult and 22 immature females, the corresponding figures were 14.6 and 14.4%. None of the differences are statistically significant.

HABITAT

In the area of our study optimum conditions were provided by open woodland or woodland edge, with grass or other vegetation kept short by grazing, and an abundant supply of flat rocks or similar shelter. Milk snakes do not ordinarily bask in direct sunlight, but obtain body heat by contacting the underside of sun-

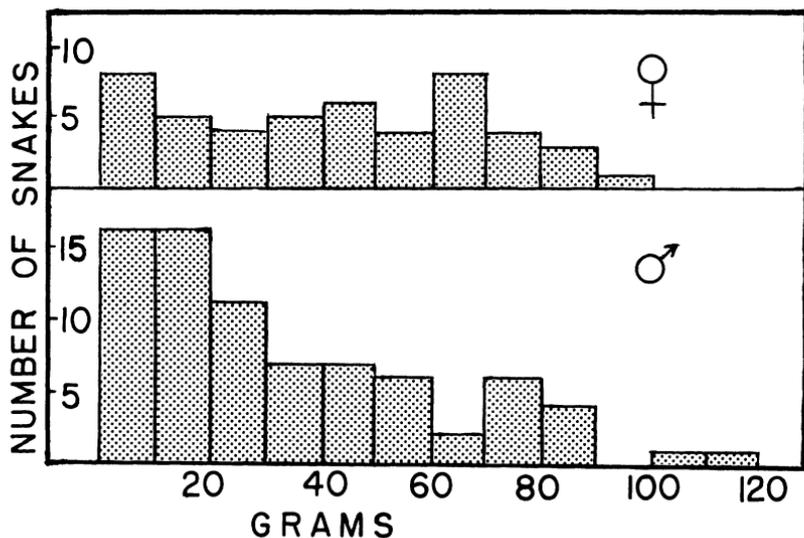


FIG. 2.—Weights of milk snakes, *Lampropeltis triangulum sypila*, in Douglas County, Kansas, and adjoining areas.

warmed objects. Flat rocks are the favorite shelter, but logs, stumps, boards and strips of sheet metal and tarpaper also are used where they are available. On the University of Kansas Natural History Reservation, milk snakes are definitely less common than they are on several other nearby areas. Also, they are less common on the Reservation than they were in the late 1940s when the area was grazed and vegetation was low and sparse. In northeastern Kansas where milk snakes have been found, other species of reptiles have been found in larger numbers. Although some species are directly involved in the ecology of the milk snake as its prey or predators, their occurrence with it reflects similarity in habitat preferences. Table 1 shows the number of milk snakes and of other common local reptiles collected on various occasions in April and early May at several localities. The ringneck snake, *Diadophis punctatus*, is the most abundant and consistent associate of the milk snake, and it cannot be arbitrarily classified as either a woodland or a grassland species. The Great Plains skink, characteristic of prairie habitat, the five-lined skink and worm snake, characteristic of woodland edge and clearing, also were frequent associates. All four of these small reptiles are important prey of the milk snake. Not included in the table, because they were found only in small numbers and only on one or two occasions, are *Lampropeltis getulus*, *L. calligaster*, *Pituophis melanoleucus*, *Opheodrys aestivus*, *Storeria dekayi* and *Ophisaurus attenuatus*.

TABLE 1.—Number of milk snakes and other common reptiles found at the same times and places in Douglas, Franklin, Jefferson, Johnson, and Leavenworth counties, Kansas.

Locality	Date	<i>L. triangulum</i>	<i>D. punctatus</i>	<i>E. fasciatus</i>	<i>C. vermis</i>	<i>C. horridus</i> , <i>A. con-</i> <i>tortrix</i> , <i>E. obsoleta</i>	<i>C. constrictor</i>	<i>E. obsoleta</i>	<i>T. ornata</i>
Bonner Springs	14 May 1967	1	—	4	5	1	1	—	1
Holliday	13 May 1967	1	1	1	11	1	—	1	—
Sunflower	7 May 1967	2	1	18	39	7	—	1	5
1 mile E Eudora	11 April 1967	1	21	6	1	—	1	1	—
Pleasant Valley	29 April 1967	2	12	7	26	4	—	6	3
Pleasant Valley*	22 April 1967	2	69	1	1	—	—	1	—
Pleasant Valley*	22 April 1967	4	16	1	16	—	—	10	—
8.5 miles S Lawrence	22 May 1966	3	7	6	15	—	—	7	2
8.5 miles S Lawrence	30 April 1966	4	47	3	24	—	4	18	—
11 miles S Lawrence	14 May 1966	3	19	many	6	6	—	—	—
Gould's Ford	26 April 1966	4	10	—	23	2	7	3	—
3 miles ESE Ottawa	30 April 1963	2	few	2	—	5	—	4	—
6 miles N Reservation	18 April 1963	4	167	16	14	5	3	4	—

* Two areas at the same locality.

MOVEMENTS

Of 58 milk snakes marked and released on the Reservation, only 11 were recaptured. Two were recaptured three times, another twice, and the remaining eight only once. Six snakes were recaptured after periods of weeks in the same growing season that the snake was marked; four were recaptured after one hibernation, one after two, one after three, and one after five. The snakes seem to stay within familiar areas. A hatchling marked and released on 25 August 1966 was recaptured at the same place on 4 September, 21 September, and 20 May 1967. A juvenile captured on 11 June 1951 was found again beneath the same shelter on 17 July 1951. A half-grown male released on 26 May 1955 was recaptured as an adult nearly 4 years later, 900 ft from its release point. After intervals of 11.5 months and then 2.5 months, it moved 250 ft and 1300 ft respectively.

Excluding two juveniles recaptured at their original locations, six milk snakes made movements of 250–1300 ft (\bar{x} = 832.5). Six of the distances were within 800–960 ft. Two randomly selected points within a home range would be separated on the average by a dis-

tance of half the range diameter if intensity of use is fairly uniform within the area (Fitch, 1958). Assuming that 832.5 ft represents a typical home range radius for the milk snake population studied, a home range of 50 acres is indicated—an area somewhat larger than those calculated from similar but more numerous records for the rat snake, racer, copperhead, and garter snake at the Reservation.

REPRODUCTION

On 14 May 1966, an adult male (65 cm SVL) and female (57 cm SVL) were placed together in a cloth bag. When they were removed from the bag at 2200 hr on 15 May, the pair was copulating. The male grasped the female's neck about 3 cm behind her head. On 9 May 1965, a pair (male 63 cm, female 67 cm) was found copulating under a flat rock. Their body temperatures were 24 C and air temperature was 24.6 C. On 27 April 1960, a pair was found under a piece of tarpaper (male 64 cm, female 57 cm). The female's cloaca contained semen with abundant motile sperm, indicating recent copulation. On 23 May 1962, a funnel trap in tall grass on the Rockefeller Experimental Tract near the northern edge of the Natural History Reservation contained an adult female milk snake and four adult males.

Five adult females (four in the latter half of May and one on 17 June) had enlarged oviducal eggs which were palpated to determine size of clutch; three had seven, one had six and one had nine. Snout-vent lengths (cm) and weights (grams) of the females that laid seven eggs were: 51, 48; 52, 61; 68, 80. The one that laid six eggs was 56 and 62, and the one that laid nine eggs was 64 and 86.

Two females laid their clutches in confinement. One laid 5 eggs (18 June 1962) which measured (mm) 33×14.5 , 31×14.5 , 31×15.5 , 33×15.5 , and 34×14.5 . Three of the eggs were adherent. Weights for all the eggs averaged 5.32 g. The second female laid a clutch of 5 eggs on 2 July 1966. Kept at room temperature, these eggs hatched on 15 September 1966. The young weighed from 2.5–3 g. Four males were 201, 200, 198, and 194 mm SVL and the one female was 190 mm SVL. The eggs were in an adherent cluster weighing 19 g. Their individual measurements (mm) were 35×13 , 34×13 , 33×13.5 , 33×13 , and 30×13 .

Another female of 560 mm (SVL) captured and kept by Joseph T. Collins, to whom we are indebted for the record, laid seven eggs on 2 July 1970. These averaged 31.6 (29.3–34.9) mm long and 13.9 (12.7–14.5) mm wide.

Records of additional clutches of *syspila* with 6 and 8 eggs were published by Loomis (1948) for Adams County, Iowa, and by Gloyd (1928) for Franklin County, Kansas. For the total of 10 clutches, the number of eggs average $6.7 \pm .437$. Wright and Wright (1957) published figures for 16 separate clutches of *L. t. triangulum*

mentioned in earlier publications with 6, 6, 8, 8, 9, 11, 11, 11, 12, 13, 13, 13, 15, and 24 eggs. Conant (1951) reported clutches of 16, 17, and 26. These 19 clutches of *triangulum*, contrasted with the 10 of *syspila*, provide evidence of notable geographic variation in size of clutch such as has been demonstrated in several other wide-ranging reptiles (Fitch, 1970).

Size of clutch is presumably adjusted to normal mortality factors and size of the adult. *L. t. triangulum* has been reported to attain a total length of 137 cm, whereas the largest *L. t. syspila* that we examined was about 92 cm.

GROWTH

Most hatching probably occurs in September. Some hatchlings may feed before entering hibernation, but judging from the small size of some young in spring and early summer, it is not uncommon for them to fail to feed before hibernation. Such individuals would grow only slightly (nourished by stored yolk) and would lose weight before hibernation. First-year young can be readily recognized as such, because they constitute a size group that is fairly distinct from older snakes. The 27 first-year young were found in late April, May or early June (except for one found 25 July and one 25 August) and ranged from 198–268 ($\bar{x} = 237$) mm SVL. The male average of 234.4 mm SVL ($N = 18$) was not significantly different from the average of 223.1 mm ($N = 9$) in females. Assuming that the hatchlings obtained from eggs incubated in the laboratory were of typical size, the hatchlings captured in spring had grown an average of about 30 mm, or 15% over their original length in about 2 months of active life. However, some of the fastest growing had gained twice that or more, and four young (captured on 16 April, 29 May, 11 June, and 18 June respectively) had made little or no growth since the preceding summer—at least they were still within the expected size range of hatchlings. Four other first-year young were definitely larger than hatchlings but were so small that they seemed retarded. Probably in most cases such stunted individuals are destined for early elimination and hence are not represented in the older age classes.

The 19 other first-year young not considered retarded or stunted ranged from 220–268 ($\bar{x} = 240$) mm SVL, having gained about 40 mm in about 2 months of active life. At this rate of gain they would have attained an average length of 360 mm in their second spring. Twenty-three snakes in our series, ranging from 296–397 ($\bar{x} = 360$) mm SVL, are thought to represent this second-year group. There is no sound basis for judging where the boundary between second- and third-year snakes should be drawn. Almost certainly some overlap between the two groups occurs, but 400 mm

TABLE 2.—Growth of marked and recaptured milk snakes.

Number and sex	Dates of capture	SVL (mm)	Weight (g)	Age and growth
1, male	5-26-55 5-17-59	375-630	14-73	Halfgrown second-year size to average adult in 4 yr.
2, male	6- 7-61 5-18-64	547-629	48-68	Small adult to average adult in 3 yr.
3, female	5-29-64 5-27-65	428-604	25-65	Adolescent (3rd year?) to adult in 1 yr.
4, female	9-13-65 8-11-66	533-620	52-69	Small adult to average adult in 11 months.

SVL is tentatively selected as the length most likely to separate the groups correctly.

Third-year milk snakes are still growing rapidly and are usually more than 400 but less than 500 mm SVL. One male that was probably in this age class was 477 mm SVL and had abundant sperm, some of them motile, on 14 May 1966. A female, 472 mm SVL on 5 May 1966, had a distinctly thickened cloacal capsule, an indication of sexual maturity or at least adolescence. She may have been in either her third or fourth year.

Recapture records are of little use in showing growth rates. Although three first-year snakes were recaptured five times, intervals were only a few weeks in most instances. Stunting from handling and marking was evidently involved, as none made normal growth. Those that made significant growth were half-grown or larger when they were marked, as shown in Table 2.

These records suggest that fairly rapid growth continues beyond the attainment of sexual maturity into the third, fourth and fifth years. By this time they may be adults of larger than average size. The largest adults are probably 6-10 years old in most instances.

FOOD HABITS

Information concerning food habits was obtained by palpating undigested food items from stomachs and by microscopic analysis of fecal droppings. These data were supplemented with observations on confined individuals. Small vertebrates make up most if not all of the food. Twenty natural food items were recorded as follows: 12 *Eumeces fasciatus*, 2 *Diadophis punctatus*, 4 *Cryptotis parva*, 1 *Eumeces obsoletus* (juvenile, tail only), 1 *Carphophis vermis*, and 1 *Peromyscus maniculatus*. One of the *E. fasciatus* was in a milk snake captured 25 September 1964; all other food records were for late April, May or early June. One of the five-lined skinks eaten was a gravid female which must have been caught in its nest burrow, and perhaps most of the skinks are captured when they are inactive.

The head and jaws of the milk snake are small and delicate, and the body is slender, not adapted for ingestion of bulky prey. Most small rodents and lizards occurring within the range of *L. t. sypila* are too bulky to be ingested except by large adults. Anderson (1965) reported that a milk snake he captured in Missouri disgorged a *Peromyscus leucopus*. Another ate six worm snakes but no ringneck snakes when placed in a bag with a mixed group.

Smith (1956) stated that the food of milk snakes includes small mammals, birds, insects, earthworms and spiders. Presumably this statement was based largely on literature records of the eastern *L. t. triangulum* which probably differs from *L. t. sypila* to some extent in food habits. Nevertheless, published records of feeding on invertebrates cannot be accepted uncritically, and there is always a chance that the material may be secondary as residue from the digestive tracts of small vertebrates such as lizards.

Although the five-lined skink is by far the most frequent food item in the area of our study, its range extends only a little farther west and it is absent from most of Kansas. Where it is not present, there must be a partial change in food habits of the snakes.

Milk snakes in confinement often fed upon five-lined skinks and newborn mice, but they were disinclined to accept other items. Prey was killed by constriction. On one occasion two adults of approximately equal size seized the same food item and one snake was partly ingested by the other. After several hours the one swallowed was disgorged dead.

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OBSERVATIONS ON THE OCCURRENCE OF *DESMOGNATHUS MONTICOLA* IN FLORIDA

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ABSTRACT: *Desmognathus monticola* is reported from Escambia County, Florida. Sex and reproductive condition is discussed for 78 dissected specimens. There is a loss of prevomerine teeth in males correlated with increasing testicular lobe number. The dorsal color pattern of the Florida specimens is uniformly light brown with scattered black spots; larvae and juveniles usually have 10–12 pairs of light brown spots set off by black melanophores. The venter is white in larvae and young juveniles and mottled in older juveniles and adults. Laterally, most specimens are bicolored. A distinct row of ventrolateral white spots persists through all age classes.

THE plethodontid salamander *Desmognathus monticola* Dunn was primarily known as a montane species until Rose and Dobie (1963) reported it from the Coastal Plain of Alabama. Since then others have shown that *D. monticola* ranges throughout the western half of the Alabama Red Hills physiographic region (Brandon, 1965; Folkerts, 1968).

On 23 November 1969, we collected 15 *D. monticola* from a ravine (T5N, R31W, NW $\frac{1}{4}$ Sec. 21) ca. 4 miles E Bluff Springs, Escambia County, Florida. These appear to be the first record of this species from this state and represent the southernmost population known. Two collections were made during December 1969 from this and 4 other ravines which head in the NE $\frac{1}{4}$ and W $\frac{1}{2}$ of Section 21. The total number of specimens was 78, including 8 larvae.

The ravines are fed by seepage water at their heads and for a distance of up to 30 m downstream. Together the five ravines are the source of an unnamed tributary of Canoe Creek. The water is clear, sometimes tumbling, and of relatively even temperature (10 C