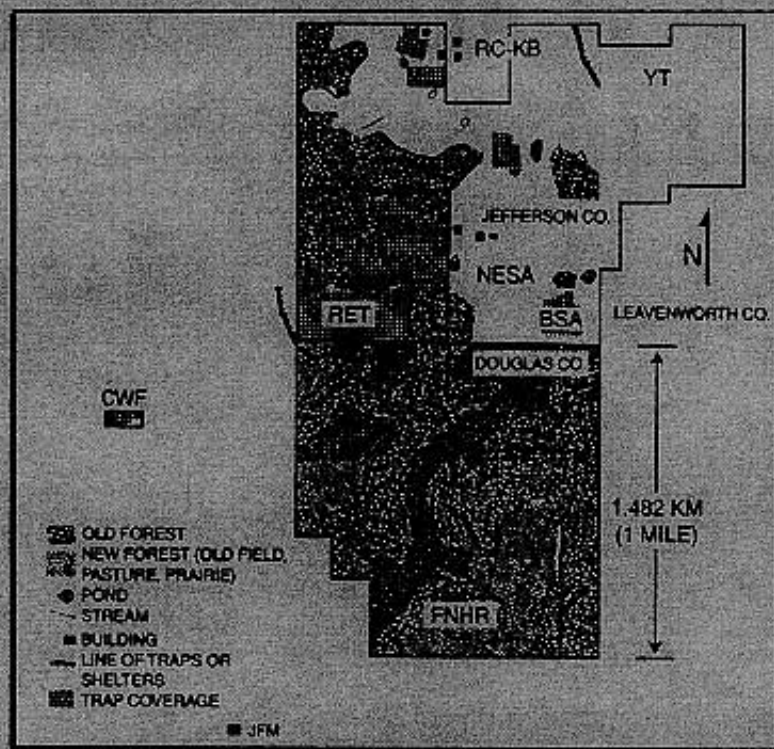


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REPRODUCTION IN SNAKES
OF THE FITCH NATURAL HISTORY RESERVATION IN NORTHEASTERN KANSAS

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Abstract—Over the past 55 years, life history information has been collected for the assemblage of snake species occurring on the Fitch Natural History Reservation (FNHR). For each species, facts such as sex ratios, the time required for individuals to reach breeding maturity, ratios of non-breeders, usual numbers of young per clutch or litter, and the effects of environmental factors have accumulated. Much of this information was published in my recent book (Fitch, 1999). However, traits such as those mentioned are subject to change in time and space. A reexamination of the data, supplemented by five years of additional records has permitted some extension of the original conclusions. This report includes *Agkistrodon contortrix*, *Carphophis vermis*, *Coluber constrictor*, *Crotalus horridus*, *Diadophis punctatus*, *Elaphe obsoleta*, *Lampropeltis calligaster*, *Lampropeltis triangulum*, *Nerodia sipedon*, *Pituophis catenifer*, *Storeria dekayi*, and *Thamnophis sirtalis*; for each of these new facts are available. *Elaphe emoryi*, *Lampropeltis getula*, *Storeria occipitomaculata*, *Tantilla gracilis*, *Tropidoclonion lineatum* and *Virginia valeriae*, also present on the area, are not included because no new information is available for these species.

Key words: Clutch size, litter size, natural history reservation, non-breeders, and palpation.

METHODS AND MATERIALS

To determine the reproductive potential of each species I undertook to allocate each adult female as a breeder or non-breeder. In early summer breeders could usually be easily recognized by their distended abdomens containing eggs or embryos, and they were likely to have weights much exceeding those of nonspecific males of the same SVL. The females of oviparous species oviposit in early summer. After ovipositing they are noticeably thin and underweight—lighter than conspecific males of the same SVL. In viviparous species also, there is an abrupt reduction in weight, below that of conspecific males of similar SVL, but it takes place in late summer. Non-breeders, not affected by eggs or embryos, usually have weights similar to those of male counterparts of the same SVL, or are somewhat lighter.

DISCUSSION

Agkistrodon contortrix

Individual histories of marked snakes caught several or many times were useful for defining breeding schedules (Fitch, 1960). Some of the snakes checked were from sites in Douglas County other than FNHR (Figure 1), e.g. from property of the late Robert G. Mengel, about 5 miles WSW, and from Clinton State Park about 10 miles SW. Thirteen female Copperheads that produced litters were recaptured in the year following that in which they produced a litter, and none

was gravid. Ten others were recaptured in the third year after reproducing, and none of these was gravid either. In contrast, four females were each known to have been gravid again in the second year after producing a litter, and two were gravid again in the fourth year. Thus, 29 snakes seemed to conform to the pattern of reproduction in alternate years, whereas a single female was gravid at captures three years apart. This individual, living on the University's Biotic Succession Area (BSA, NESAs), with an abundant vole population for food, was much bigger than any other female at its last capture (825 mm SVL, 572 g.) and perhaps was thriving to the extent that she could produce a litter annually. In four other recaptured females, known to have produced litters, reproduction did not occur again in the fifth year (in two), but may have occurred in the sixth, eighth, and tenth year after giving birth. Over the years 1980 to 2002, I found an average of 5.75 ± 0.14 (3–13) in 187 litters, many counted as fetuses in female oviducts.

Carphophis vermis

In Western Worm Snakes, sexual maturity is attained at a much smaller size and earlier age in males than in females (Clark, 1970). The smallest male found to have active sperm was 177 mm in SVL, and typically this size is attained by snakes that are in their second autumn and are about fourteen months old. Most females pass 200 mm SVL early in their third year, and become parents as three-year-olds. Of 44 adult females in spring, 27 were above normal

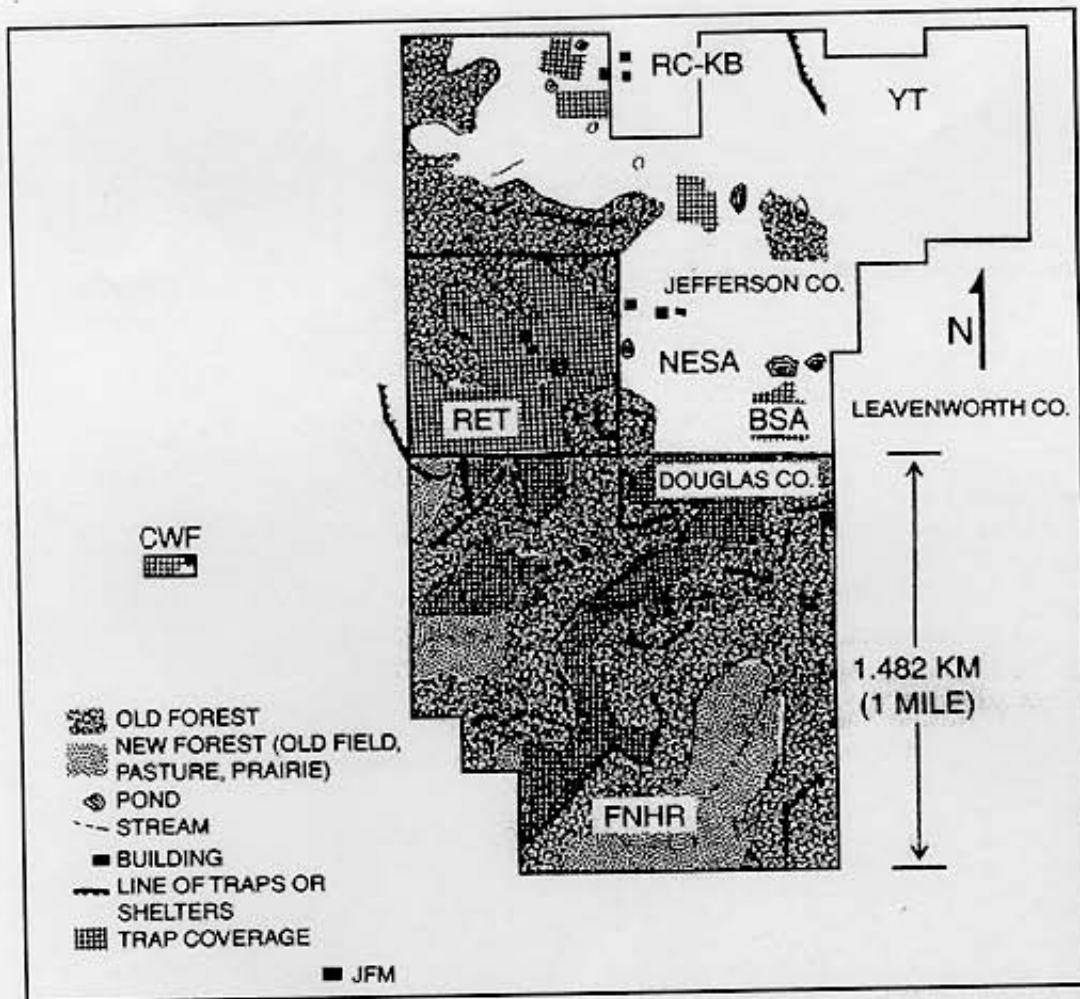


Figure 1. A map showing the location of the Fitch Natural History Reservation (FNHR) in Douglas County, northeastern Kansas.

weight, suggesting that they were gravid, and six other were underweight, suggesting that they had recently laid eggs. These 33 were tentatively allocated as reproductive, whereas eleven others that approximated the normal weight for males of their sizes were considered to be non-breeders. I conclude, tentatively, that about one-fourth of females do not breed in a normal year. Eggs average about 2.5 per clutch.

Coluber constrictor

All female Eastern Racers captured in the years 1976 to 2000 in June and July were critically examined to define reproduction more thoroughly than was done previously (Fitch 1963a). In the sample of 126 females, 48 were relatively heavy and were thought to have ovarian or oviductal eggs; 65 others, mainly from late June or July, were underweight, and were identified as breeders who had already laid their

clutches. Twelve others had intermediate weights (being neither plump nor lean), and these suspected non-breeders made up 9.5 per cent of the sample. From 1980 through 2002, 69 counts of clutches were obtained; they ranged from 5 to 21 and averaged 12.1 ± 0.41 .

Crotalus horridus

In my long term study of Timber Rattlesnakes, it was determined that males of the local population mature in two years, females in three, and that these intervals represent relatively rapid development compared with the rates prevailing in some other parts of the geographic range. In northern New York, Brown (1991) found that female reproduction usually first occurred in the snakes' ninth or tenth year. In the Appalachians, Martin (1992) found that several years might elapse between births for a female's litters. In

Pennsylvania, Galligan and Dunson (1979) found that females matured in five years and seemed to have a breeding cycle of two or three years.

Thirty-four adult and adolescent females were recorded during the 55 year span of my field work; fourteen of these were known to have been reproductive, including five that produced litters and nine that were palpated and found to contain fetuses, or were salvaged as DORs, dissected, and found to contain embryos. Nine others were judged to be reproductive on the basis of weight – heavier than normal for their SVL's. On the other hand five (11.8%) were near average male weights for their SVL's, and were judged to be non-reproductive. The remaining seven were judged not to be useful for studying reproduction, as they were captured in early spring or fall, or were pre-reproductive. Fourteen litters (born in captivity or palpated as fetuses) averaged 7.5 ± 0.65 (5 to 14), with standard deviation of 2.44.

Diadophis punctatus

Males of the Ringneck Snake may breed in their second autumn at an age of about fourteen months. Females require an additional year to mature and at the earliest breed in fall when they are about 26 months old, or, more likely, breed the following spring at an age of 31 months (Fitch, 1975). Nearly all adult females take part in the annual breeding season. For the six-year period, 1992 through 1997, in June, 106 egg-bearing females were captured, along with three that were not gravid. In 1966, there were 25 egg-bearing females, with just one that was not gravid. For these combined samples the ratio of non-breeders is just under three per cent (2.96). Perhaps the ratio of non-breeders fluctuated around that figure from year to year, under influence of weather and other factors. For 267 clutches of unlaidd eggs (counted by palpation), the average was 3.96, but for fifty clutches that were laid, the mean was 3.36 eggs.

Elaphe obsoleta

Over a 55-year period, 100 adult and adolescent female Western Rat Snakes were examined for reproductive condition in early summer (28 May to 4 August). Forty-eight were relatively heavy, and were tentatively allocated as breeders; twelve others that were underweight were considered to be parturient, whereas the remaining forty had weights within five per cent of those of males of the same length, and were tentatively considered to be non-breeders. Thus, it seems that about 60% of females breed annually and 40% are non-breeders. Twenty-two clutch counts

are available, from unlaidd eggs palpated, clutches laid in captivity, and DOR traffic casualties (Fitch, 1963b). Clutches averaged 10.7 ± 0.98 eggs, ranging from 5 to 27.

Lampropeltis calligaster

Of 49 adult female Prairie Kingsnakes captured in June and July, 33 were heavier than average, and some of these were obviously gravid, containing eggs that could be palpated; eight others, taken late in the season, were below average weight, some appearing emaciated, and were identified as parturient, whereas sixteen (28.1%) weighed approximately the same as male counterparts of the same length, and were tentatively considered non-breeders because they were neither gravid nor parturient. Thus it seemed that to little less than one-fourth were non-breeders (Fitch, 1978). Twelve clutches (laid in captivity, found in the field, or palpated in females before laying) averaged 8.83 ± 0.61 , with range of 6 to 13.

Lampropeltis triangulum

Of 93 adult female Milk Snakes captured, 26 in early summer were substantially heavier than male counterparts of approximately the same size, and were suspected to contain ova that increased their weights. Fourteen others in late summer were substantially lighter than male counterparts and were suspected to have laid recently. Ten (10.8%) in late spring and summer (May through August) weighed about the same as male counterparts, and some or all of them may have been non-breeders.

In this widely ranging species, individuals of tropical populations may produce more than one clutch annually. Tryon and Murphy (1982) mentioned double clutching in captivity in four tropical subspecies, and one snake produced three clutches in the same season (30 May, 19 July, and 4 September). In my study, nineteen clutches laid in captivity or palpated in females' abdomens before laying averaged 6.84 ± 0.51 , with a range of 4 to 13.

Nerodia sipedon

Of eighty adult female Northern Water Snakes examined, 54 (67.6%) were above normal weight for their sizes and were suspected to be gravid; thirteen that were palpated were found to be gravid, whereas 26 (32.4%) were approximately the same weight as males of similar SVL and were suspected to be non-breeders. I tentatively conclude that about one-third of females do not produce litters each year. Seventeen litters averaged 20.8 ± 2.22 (5-36).

Pituophis catenifer

The Bullsnake was moderately common at the outset of my study, but was unfavorably affected by habitat change from short grass to dense ground vegetation and finally to forest. Its numbers dwindled rapidly; only one was captured on FNHR in the fourth decade of fieldwork and none thereafter. A total of 37 adult and adolescent females were captured on FNHR and the adjacent Nelson Experimental Area (where the species still persists). Seventeen of these were caught in late May or June. Two were much above the normal weight for their SVL and four others were somewhat heavier than normal; these six were assumed to be gravid. Seven other females had weights near the average for males of their lengths, and these were tentatively designated as non-breeders. It seemed that about 41.2% of the local population consisted of non-breeders. I recorded five egg clutches, which averaged 11.2 and ranged from 7–12.

Storeria dekayi

Fifty-two adult female Brown Snakes were captured during May and June; 29 that were palped were found to contain embryos; twenty others were above normal weight and were also thought to be gravid. Only three (5.8%) appeared to be non-gravid. In 42 females, litters averaged 11.8 ± 0.75 , ranging from 4 to 24.

Thamnophis sirtalis

Adult female Common Garter Snakes captured during the six-year period 1990 through 1995 were checked for reproductive status. Of the 191 total, only sixteen (7.8%) were non-reproductive, but the ratio changed from year to year as follows: 12.5% in 1990, 12.1% in 1991, 8.4% in 1992, 4.0% in 1993, and 5.8% in 1994. For 584 litters, the average was 16.8; the mean of 28 annual means was 15.4.

CONCLUSIONS

The snakes of most local species in northeastern Kansas reproduce annually. The copperhead is an exception; most females of this species produce litters in alternate years, but under exceptionally favorable conditions (one of 27 in my sample) may reproduce in consecutive years. In those species that reproduce annually, a small percentage of females may not participate in the annual breeding season, and this minority fluctuates from year to year depending

on environmental factors such as weather, food supply, disease and parasitism. For the following species, the average percentage of abstainers is presented: *Carphophis vermis* 2.5%, *Coluber constrictor* 10.3%, *Crotalus horridus* 11.8%, *Diadophis punctatus* 3.0%, *Elaphe obsoleta* 25.0%, *Lampropeltis calligaster* 28.1%, *Lampropeltis triangulum* 10.8%, *Nerodia sipedon* 32.4%, *Pituophis catenifer* 41.0%, *Storeria dekayi* 5.8%, and *Thamnophis sirtalis* 7.8%.

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