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Observation of aberrant growth in a Timber rattlesnake (*Crotalus horridus*)

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In *Crotalus horridus*, a species in need of conservation in Kansas (Brown 1993), growth is generally positively correlated with the number of rattle segments, in accordance with the frequency of ecdysis. In compiling 17 years (1990-2006) of timber rattlesnake morphologic data from a population in northeastern Kansas, Fitch and Pisani (2006) noted that, among males, snakes whose snout-vent length (SVL) fell within the range of 628-720mm (mean = 675.2mm) typically exhibited a button and 3 additional rattle segments. An overlap in this range is seen with individuals bearing a button plus 2, 4, 5 or, at most, 6 segments in a rattle that normally would show appreciable distal taper. Therefore, the collection of an anomalous male snake (Fig. 1) from northeastern KS weighing 199.5g, with a SVL of 668mm and an incomplete string of 18 rattle segments in May of 2007 was unexpected. Predictably, aside from the terminal segments, the rattle was not markedly tapered (see Table 1 below), an indication that growth did not accompany the addition of new segments beyond the fourth or fifth shed. This period is typically when the most significant (p=0.95) gains are made in the growth of northeast Kansas timber rattlesnakes (Fitch and Pisani 2006). The high correlation between segment width and incremental growth of rattlesnakes is well-documented (Fitch and Pisani 1993; Klauber 1956).

Two other males collected from the same site this year bearing far fewer rattle segments (6 and 8) of roughly the same widths weighed 240 and 325g and exhibited SVLs of 760 and 785mm, respectively. Our aberrant male snake, then, is appreciably smaller than these males yet possesses more than twice as many rattle segments. This plus the uniform widths of the most recent 12 segments indicates a lack of proportionate growth with each additional shed.

The essentially static growth exhibited by this individual over its last 12 sheds is hypothesized to be the result of one of the following:

1. A dermal or epidermal irritant (e.g. a fungus or ectoparasite) may have expedited his shedding frequency, not allowing sufficient time for growth between successive sheds.
2. Encroaching human development at the collection site and consequent foraging constraints have permitted this snake to meet only his minimum energetic maintenance requirements.
3. Hypothyroidism may have resulted in increased shedding frequency and concurrent weight loss (Chiu et al. 2005, Rivera and Lock 2008).

Because the shedding cycle transpires over a period of a few weeks, if this individual suffered from a pathology that promoted consecutive rounds of ecdysis, he may have remained at his current size for as few as six to eight months. At the opposite extreme, if he shed at the more typical rate of two to three

Table 1. Profile of rattle segment length (mm) in aberrant male timber rattlesnake.

Rattle Segment	Length (mm)	Rattle Segment	Length (mm)
Basal	11.04	9	10.97
1	11.26	10	10.35
2	11.08	11	10.38
3	11.21	12	9.68
4	11.46	13	9.05
5	11.60	14	8.73
6	11.01	15	8.13
7	10.86	16	7.31
8	11.05	17	flange

times annually (William S. Brown, pers. comm. to GRP) without concomitant growth, he may have remained this size for as many as twelve years.

We feel that the first explanatory hypothesis, though possible, is unlikely as the snake showed no observable external signs of pathology (i.e. abscesses, blisters or fungi, abnormal behavior). It was alert and of average mass for its length.

The second hypothesis also seems unlikely. Snakes collected from this population (and therefore subject to the same selection pressures) at the same time were uniformly healthy in overall appearance. Reproduction in the population was typical of other NE Kansas populations (Fitch and Pisani 2006), with a relatively high frequency of gravid females collected this year at the same site (7 of 16 (44%) adult females). Such a high rate of reproduction suggests, as in other NE Kansas populations, that prey is abundant in the area (Pisani and Fitch 2006). Additionally, with growth rate and frequency of ecdysis being proportional, a reduced growth rate due to reduced foraging success would lead to a decrease in shedding frequency that would be reflected in fewer rattle segments.

Though we cannot with absolute confidence rule out either of these two hypotheses, the third seems to be the most parsimonious. Though we conducted no internal anatomical evaluation or hormonal assays (the latter being an emergent field of its own—see review in Rivera and Lock 2008), hypothyroidism is a promising causative agent of this morphological aberration. However, other metabolic causes of stunted growth cannot conclusively be eliminated. Reduced fitness is an expected consequence of the reduced growth seen in this male (see review in Werner and Gilliam 1984).

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Figure 1. Anomalous male snake (left) after capture and processing. For scale, the snake in the center, whose rattle appears at right, is a female (SVL 753mm).

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