

Comments on the Courtship and Mating Mechanics of
Thamnophis (Reptilia, Serpentes, Colubridae)

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ABSTRACT—Detailed observations on the posterior courtship/pre-coital actions of a pair of *Thamnophis sirtalis parietalis* are presented. It is hypothesized that courting males of this species effect initial cloacal alignment with females via adjustment (after twining) of the tail tip to approximate that of the female. Final location of the female's cloaca is believed to be by means of knobbed supra-anal keels. A hypothesis on the functional value of enlarged basal hemipenial spines is presented. It is suggested that these hypotheses might apply to other natricine snakes. Some lines of investigation centering on these hypotheses are introduced.

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INTRODUCTION

Many authors have reported the courtship activities of *Thamnophis* and related natricines (e.g. Fitch, 1970; Noble, 1937). These reports have ranged from sketchy summaries to detailed analyses of most pre-coital and coital activity. Since Blanchard (1931) described knobbed supra-anal keels in natricines and hypothesized that these serve a stimulatory function during courtship, no authors have presented alternative or supplementary hypotheses except Noble (1937: 708-709). He concluded that these specialized keels serve to provide courting male *Thamnophis* with tactile cues to courted females' supra-anal regions, thus facilitating cloacal alignment. The purpose of this paper is to report in detail the posterior movements of a courting pair of *Thamnophis sirtalis parietalis* and to present a hypothesis for tactile location of the female's anal plate and achievement of coitus by courting male *Thamnophis*. This hypothesis may be applicable to natricines in general and to certain non-natricine species.

OBSERVED ACTIVITY

On 12 May 1974, a pair of *T. s. parietalis* was observed beginning courtship in my garden (Kansas: Douglas Co.: Lawrence, 511 Lake St.); predominant vegetation is *Hemerocallis* spp. and *Iris* spp. providing ground cover of $\pm 70\%$. The pair is part of a resident population of this species established there for at least four years. These snakes utilize a rock-garden mound 1.25 m high and 2.5 m diameter as a hibernaculum.

Weather: 11 May—heavy thunderstorms from ca. 0600 to 0900 followed by clearing; air temperature 70°-80° F.

12 May—heavy rain (about 4 cm) in early AM followed by clearing about 0900; sky totally clear by 1000; moderate breeze from south; sun bright; air temperature from 72° F to 79° F during observations.

The population had been active for several weeks. The male measured ca. 460 mm total length, the female ca. 610 mm (lacking about 70 mm of tail).

The male was first observed when about 30 cm west of the female. She was coiled in a patch of sunlight. The male crawled directly to her and began the early sequences of courtship (tongue flicking, chin rubbing) described by Noble (1937) and Blanchard and Blanchard (1942).

A smaller male (ca. 300 mm) approached the female (direction not noted) and attempted courtship, but remained only about 2 or 3 min. The early courtship sequences of the original male were completed in less than five minutes. He then positioned himself next to the female and attempted to bring his cloaca proximate to hers. He moved his tail beneath hers, wound it about hers and then adjusted his position along her body until the tip of his tail closely approximated the stump tip of hers. This positioned his vent about 40 mm ahead of hers. Then, he rotated his cloacal region to his right, simultaneously adjusting it so that this small part of his body was at a 90° angle to the female's long axis. The male's anal scale now was directed forward, with the left supra-anal dorsal scales contacting the female's ventral surface.

The male's cloacal region was then elevated (wedge-like, as reported by Noble, 1937) and rubbed vigorously along the female's ventral surface for about 10 mm, rapidly brought back and rubbed again, and this was repeated several times. The male then dropped his cloacal region to the ground, shifted his twined tail slightly on the female's body and repeated the sequence. The supra-anal dorsal scales were pressed against the female's vent during rubbing, which was always from posterior to anterior; no back-and-forth action was seen. Examination at the end of my observations verified the presence of knobbed anal keels on these dorsal scales. A series of undulatory waves through the male's body sometimes preceded the rubbing, and these were often accompanied by tail readjustment. No particular pattern to the tail readjustment, rubbing or undulatory sequences was discernible.

The male occasionally contracted the portion of his tail containing the left hemipenis; no protrusion of the hemipenis proper was noted, though there was a small eminence at the left margin of the male's cloaca (see Noble, 1937:676). Both sides of the male's cloaca were employed in the above activity through my observations. No switching pattern was noted. I did not note in detail the activities of the anterior parts of either snake; I assume this activity was as described many times prior for *Thamnophis*. Duration of the rubbing sequence was from 5-10 seconds. I do not know what governed cessation of it (possibly endurance of the male), but it would generally begin with male tail/body repositioning. During this latter he would shift about but always finish by trying to set the tip of his tail as even as possible with the stump-tip of hers. Readjustment and rubbing sequences would proceed during roughly 15 min intervals, each followed by a 5-15 min rest period. The male's body was frequently contorted during rubbing in an effort to keep his anal region pressed against the female's ventral surface.

The female remained totally passive throughout, as is typical of this species. Neither snake was alarmed by my presence or my slow movement through the garden after them. Observation distance varied between 30-50 cm. The pair moved a total distance of less than 1 m during the observations. The male never successfully achieved coitus, and after several hours he untwined his tail entirely from her. The pair lay quiescent for about 15 min at which time I felt courtship was about to terminate and captured the pair for examination. They were released shortly thereafter.

DISCUSSION

Noble (1937) observed the effect of taping different parts of the tails of male and female *Thamnophis* and concluded that the male supra-anal dorsal scale rows were sensitive enough to be the primary means of location of the female's cloaca. However, in the pair I observed, the male most definitively seemed to rely on aligning his tail-tip with the female's in order to position himself in the general area of her cloaca. As mentioned earlier, her tail was missing what appeared to be about 70% of its length (based on observations of many snakes of this species) and the male's orientation activity consistently placed his cloaca well ahead of hers. Published photos (cf. List, 1950: fig. 1 C,D.) of courting *Thamnophis* all show the twined tails to be very nearly even at their tips. Munro (1948) reported successful mating of a stump-tailed *T. s. parietalis* with an intact male; however, Munro's female lacked only 1/3 of its tail.

Noble's (1937) histological examination of knobbed supra-anal keels in natricines does strongly suggest a tactile capability for the knobs, as do his taping experiments. I feel these

knobs may be used for final location of the female's anal plate after longitudinal caudal adjustment brings the snakes' cloacae into proximity. The directionality of the rubbing reported above would, it seems, facilitate the tactile sensitive knobs "grating" across the trailing edge of every one of the female's ventrally oriented scales encountered. As of all these scales, the anal plate has the greatest freedom of movement at its posterior margin, it seems likely the courting male could detect it. To crudely explore this thought while watching the courting pair I, at one of the male's rest periods, inserted the callous roughened palmar surface of the tip of my index finger beneath the female's tail and moved it forward—she showed no agitation and the male remained at rest. The ease with which the callous surface engaged the female's scales was greatest for the anal plate, less for the ventrals and least for subcaudals. The test was conducted several times with identical results.

To allow me to further explore my hypothesis, Henry Fitch kindly permitted me to examine his field notes. The notes which Fitch felt would be most helpful were those encompassing 1959-1963, the years of most of the observations for Fitch (1965). Additional observations of value were found through 1965. Observations were narrowed by selecting those between mid-June and 31 August (when gravid females would be most apparent without dissection), by examining records only for females with broken tails, by eliminating data on recaptures (Fitch advised that tails were occasionally broken during measuring), and by using only specimens beyond the two-year size range. This left a regrettably small number of specimens (22). These were divided into Fitch's (1965) age-size classes and the percent of gravid snakes compared to percents for these classes in the publication. The group percentages of gravid females with broken tails were marginally non-significantly different ($\alpha = 0.05$) from Fitch's (1965). This marginality coupled with the small sizes of my groups ($n=4-9$) suggests that an intensive investigation has merit.

At this point, it seems worthwhile to dwell upon a likely mode of action of the hemipenis in mating. Over the past few years, I have observed the structure and eversion of hemipenes of various natricines. As is well known, these are well spined and typically have a few disproportionately large spines most basal. During eversion, the tips of these large spines describe arcs of between 180° - 270° . I feel the primary purpose of these basal spines (which are the first to appear upon hemipenial eversion) may well be to swing out and hook the female's anal plate margin and/or cloacal edge during entry of the hemipenis. They may also help slightly spread the female's cloacal opening. The numerous small spines (and probably the larger as a secondary function) almost certainly serve to hold the hemipenis *in situ* during sperm transfer as reported by many authors.

In conclusion, much work needs to be done to adequately explore the hypotheses I have set forth here. Since many species with keeled scales have knobbed supra-anal keels and many smooth-scaled species of diverse families have keeled supra-anal scales, the comparative mechanics of snake courtship and mating appears a fruitful and wide open field. Carpenter (personal communication) pointed out that the sexual dimorphism in relative tail length in natricines might invalidate or considerably complicate my hypothesis, but added that if the hypothesis was correct it could "... be one reason why female natricines are usually larger than males."

My observations raise the question of tail damage to *Thamnophis* (and other genera?) as a factor in individual reproductive failure. Is there a minimal percentage of female tail needed to facilitate male orientation? Do males with tail damage have trouble orienting to intact females? Could any resultant reproductive failure be a factor in selection for alertness (assuming attempted predation to be a major cause of tail damage)? Why have no snakes evolved anatomically elaborate tail autotomy mechanisms as have many lizards, including elongate legless ones? It is my sincerest hope that this paper will encourage the investigation of these and related questions.

ACKNOWLEDGMENTS

For fruitful conversation through the gestation of this paper I thank Alan Savitzky, Richard Wassersug and Barbara Waters. Sincere thanks are also expressed to Charles Carpenter

and Henry Fitch for critically reading the manuscript, to Nancy Busija for typing it and to Richard Perkins for the use of his Hewlett-Packard model 9810 desk computer.

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