NOTES ON THE COURTSHIP AND MATING BEHAVIOR OF THAMNOPHIS BRACHYSTOMA (COPE)

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Data on the mating behavior of snakes undisturbed in their natural habitat are comparatively few in the literature. Such data have been reported for the genus Thamnophis by Breder (1946), who observed courtship in T. sirtalis sirtalis. Observations of breeding in captivity have been reported for T. s. sirtalis (Blanchard and Blanchard, 1940; List, 1950) and for T. s. parietalis (Munro, 1948).

On April 17, 1966, while collecting on a hillside in the town of Olean, Cattaraugus Co., New York, an opportunity arose to observe the courtship and mating activities of two pairs of the short-headed gartersnake, Thamnophis brachystoma. The southwest-facing slope is a known hibernaculum for this snake, and is also occupied by Thamnophis sirtalis and Storeria occipitomaculata, an association previously noted by Klingener (1957). The hibernaculum is similar in structure to the one nearby described by Bothner (1963), being located in a loose shale outcropping with accompanying shale-silt slopes, and covered in places with deposits of beech and maple leaves. The entire slope is moderately wooded. The snakes were observed among the leaves along an abandoned lumber trail which winds along the slope. Pitch of the slope varies from approximately 35°–45° from horizontal. In general, the observed behavior conformed to what Oliver (1955:225) termed the basic colubrid pattern.

At 1:00 p.m. EST, a specimen of T. brachystoma was seen crawling rapidly across the leaf litter with a smaller specimen in close pursuit. Shaw (1951) cited examples of homosexual mating behavior in Thamnophis, but later capture of these two individuals showed the former to be a female and the latter a male. During pursuit, the male's chin and labial regions were continually rubbed along the female's dorsum, and continual attempts were made by the male to align his body with hers. The female paused occasionally, at which times the male would attempt to insert his anal region beneath hers. This behavior seemed to prompt the female to move off again, a reaction noted for T. s. sirtalis by Breder (1946); the male would immediately resume pursuit. As the pair moved past other males resting in the area, these would immediately show interest in the female and join the chase. They ceased to follow, however, after traveling about three to four feet. Attraction in these cases seemed to be visual, as the active pair passed the resting males at a distance of six to twelve inches. These "secondary" males were entirely ignored by the pair.

On several occasions, the male was seen to fall behind the fe-
male. When this occurred, he apparently kept track of her route via visual means, the tongue rarely being employed, though olfaction could conceivably play a role as mentioned by Noble and Clausen (in Wright and Wright, 1957:840). Shaw (1951) observed that in some snakes, during combat, the high state of excitation resulted in the apparent subordination of chemical sex stimuli to mechanical ones. This would seem to lend support to the idea that vision may play a definite role in the courtship of these animals. The chase was observed for a total distance of about 30 feet, this being traversed by the animals in approximately three minutes, including pauses. The snakes were moving when sighted, and the distance previously traveled is unknown. At the end of this distance, the pair started to move beneath the shale fragments, at which time they were captured for positive sex identification. At no time did they show any sign of returning in the direction from which they had come, but rather proceeded in a roughly linear, downhill direction. Laboratory examination of the female's cloaca revealed very few sperm, but those present were motile. These were assumed to be either from a mating last season, or from an interrupted earlier mating this season. Snakes in this den were active during a warm spell in late March, when the temperature rose into the mid-sixties, and the latter event could have occurred at that time. Subsequent cool weather inactivated residents of the den until similar temperatures during the week preceding these observations brought the snakes to the surface again.

At 1:13 p.m., another pair was observed lying among the leaves. At this point, a fall inactivated the author's watch, so that subsequent activity could not be precisely timed. The female, again the larger of the two (s-v 320 mm.), remained relatively quiescent throughout, her head and part of her neck elevated above the leaves. The two lay side by side, their bodies in contact the entire length. The head and part of the neck of the male lay along the female's back, his snout about one-fourth of the female's total length posterior to hers. Those regions of the male's body immediately anterior and posterior to his vent were draped in single loops over the female's back, the remainder of their tails being tightly entwined. The picture they presented bears a striking similarity to the attitude of the two T. s. sirtalis observed by List (1950, fig. A) two hours after the onset of courtship. The male T. brachystoma was observed to make a rapid, spasmodic series of pre-coital courtship movements every thirty to seventy-five seconds, pressing his anal region tightly against the female's, lifting it up. No cooperation was observed on the part of the female, as was noted for an individual of T. s. parietalis by Munro (1948). The above behavior persisted for about ten minutes, at which time the male succeeded in inserting his left hemipenis into the female's
cloaca. A series of caudocephalic waves was then initiated in the male, and continued for roughly two minutes. After a brief pause, rhythmic waves were observed to now progress cephalocaudally in the male, terminating in a brief contraction of his anal region, presumably to expel sperm from his hemipenis. These waves continued at regular intervals of ten to twenty seconds for the remainder of the time that the two were in union. Their bodies were now untwined, but still in close proximity. After about twenty minutes had elapsed, the female waved her head and neck (as yet still elevated) laterally several times, then lowered her head and crawled beneath some shaded leaves out of the direct sunlight (temperature in direct sunlight 86°F., beneath leaves 65°F.). The male was dragged after her. Leaves were removed from about the anal regions of the animals so that observation could continue, and this action failed to disturb them. Behavior of the animals was not observed to differ from that described prior to their move, save that they were now in contact only at their anal regions and the female’s head was no longer elevated.

When approximately fifteen to twenty minutes more had elapsed, the female started to move into dense cover, the male still dragging behind. He made no attempt to crawl with her, but lay quietly, the cephalocaudal waves still in progress. At this point, the pair was captured and the female saved for future data on gestation period. Unfortunately, the male was accidentally lost, but measured approximately 260 mm. in s–v length.

In addition to giving some insight into the courtship behavior of *T. brachystoma*, these observations are significant in that they establish the time of the year during which this animal breeds. Mating occurs apparently immediately after emergence from hibernation, while the sexes are in close proximity. Bothner (pers. comm.) feels that the males emerge prior to the females. If so, it is possible that this earlier activity on the part of the males would increase the chances for an encounter between the sexes to occur before dispersal from the hibernaculum. Whether or not a fall mating period occurs in addition to the spring one remains to be seen.

**Literature Cited**


INITIAL APPEARANCE OF THE PAROTOID GLAND IN THREE SPECIES OF TOADS (GENUS BUFO)

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The presence of the parotoid glands is characteristic of almost all members of the genus Bufo, and these glands and their toxin have been used for varied studies. External morphology is useful as a taxonomic character (Myers and Funkhouser, 1951; and others), and the internal morphology is presently being studied with use of the electron microscope (J. L. Wittliff and R. Turner, personal communication). The secretions have been analyzed extensively (Chen and Chen, 1933a, 1933b; Hunsaker et al., 1961; Wittliff, 1962a, 1962b), and in addition, a chromatographic comparison of the secretions of many species is being made as one method of approaching the problem of phylogenetic relationships within the genus Bufo (Porter, 1962; and B. Low, personal communication).

Muhse (1909) described the morphology of the gland in different size toads. What has not yet been determined is how long it takes for the development of the gland after a toad has metamorphosed. Such information would surely be useful to those interested in gland structure and secretions. The production of various components of the secretion might be correlated with structural development of the gland, and such a study is needed.

The present study provides information as to the time of initial development and early morphology of the parotoid glands of 3 species of North American toads—Bufo houstonensis, Bufo speciosus, and Bufo woodhousei.

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