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Penis Displays of Snapping Turtles (*Chelydra serpentina*) in Response to Handling: Defensive or Displacement Behavior?

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Although many adult turtles have sexually dimorphic traits that can be used to identify the sex positively, the sex of live adult snapping turtles (*Chelydra serpentina*) is typically determined using measurement criteria that have a small, but significant, margin of error (Mosimann and Bider, 1960; de Solla et al., 1998). One usually identifies the sex of adult snapping turtles by measuring the ratio of the length from the end of the plastron to the cloaca versus the length of the posterior lobe of the plastron (Mosimann and Bider, 1960). In males this ratio is typically greater than 1.0, and in females less than 0.9. Nevertheless, there is some overlap, especially among young adults and juveniles, which may result in incorrect identification of the sex of individuals (de Solla et al., 1998). Here we describe extrusion of the penis as an aid to identify the sex of males, particularly juvenile males, and we discuss several hypotheses purporting to explain why the penis is extruded when turtles are handled.

We caught snapping turtles at Cootes Paradise (43°17'N, 79°53'W) on the shore of Lake Ontario, in Hamilton, Ontario, Canada, from early May to the end of August in 1994 and 1995. Cootes Paradise is a 45 ha eutrophic wetland with a high density of snapping turtles (Galbraith et al., 1988). Turtles were caught either by hoop trap or by hand. We usually placed the turtles upside down on overturned buckets to measure them and take blood samples.

In 1994, one of us (SRdS) noticed that male turtles that were picked up and either held vertically head up, or placed upside down on buckets, often partially or completely extruded the penis from the cloaca, sometimes for a minute or longer. We recorded these observations in 1995, because we were investigating potential organochlorine-induced feminization or demasculinization of snapping turtles occurring at this site (de Solla et al., 1998), and we used the presence of the penis to positively identify the sex of males.

Snapping turtles are large, omnivorous turtles that have a small carapace relative to body size, and a much reduced, cross-shaped plastron. They are incapable of completely withdrawing their head, tail, or limbs beneath the carapace, but have well developed behavioral defenses. In water, snapping turtles usually hide or flee when faced by an aggressor. However, when a snapping turtle is first approached on land, where it is most vulnerable, it will stop moving and lower its body to the ground. If approached closer, it elevates the posterior part of the body, often using the large tail for support. The turtle rotates to maintain orientation towards the aggressor, sometimes hisses, and initiates a gaping threat display; usually the closer the aggressor, the wider the gape. The inside of the turtle's mouth is usually bright pink or white, which contrasts strongly with the dark color of the surrounding skin and darker carapace. Often the turtle will approach and lunge violently at an aggressor, and if the turtle succeeds in biting, it will withdraw its head without letting go and push against the attacker with its foreclaws. Additionally, snapping turtles exude a foul smelling and viscous musk from glands located berneath the bridge of the plastron, and if handled will often release copious amounts of urine. If held by the carapace, the turtle will usually continue to try to bite the handler, and to use its hind feet to dislodge the handler's grip.

When a snapping turtle extrudes its penis, the tail is usually bent ventrally, thus shortening the ventral portion of the tail anterior to the cloaca. Unlike many other reptiles, in which penile erection is caused by eversion, in turtles erection is caused by tumescence of two spongy bodies: the corpus spongiosum and corpus fibrosum (Zug, 1966). The penis is bent anteriorly, and when fully extended has a fold of skin extending from the ventral side of the base of the penis from where it exits the cloaca to the tip of the penis (Fig. 1). The penis of adults is normally bright pink, which contrasts with the gray to brown skin of the tail and limbs; however, the two

Figure 1. Fully extruded penis of a large adult snapping turtle. Photo by SRdS.

Figure 2. Penis extrusion of an adult snapping turtle while the turtle is being rocked from side to side. Photo by MP.

smallest juveniles (1.0 kg and 1.4 kg) we caught had dull gray penises.

Typically, we observed that turtles extruded the penis when first handled, but that the longer they were handled, the less likely they were to display the penis. Similarly, the turtles were less likely to show typical defensive behavior after prolonged handling. While extruding the penis during handling, turtles would usually continue to struggle and snap at the handler. We discovered that snapping turtles could be induced to extrude the penis by holding the turtle vertically, with the head facing up, and gently rocking the turtle from side to side for about 15 sec (Fig. 2). This action also often increased the tendency of the turtle to display a gape threat and hiss, or to attempt to bite the handler. We observed 51 incidences of penis extrusion from 78 captures of 43 different males in 1995. We did not observe any penis extrusions when the turtles were still on the ground, or when a turtle was rolled on its back, unless the turtle was placed on its carapace on a bucket so that the turtle was unable to right itself.

To determine the usefulness of using the rocking technique to identify the sex of snapping turtles, we estimated the proportion of males that extruded the penis. Of the 69 males with a precloacal:posterior lobe ratio more than 5% greater than the largest precloacal:posterior lobe ratio of any female, 38 (55.1%) extruded the penis. Snapping turtles that did not extrude the penis were heavier (mean = 10.46 kg, range = 5.6 kg to 15.5 kg, $n = 33$) than those that did (mean = 8.33 kg, range = 1.0 to 14.0 kg, $n = 40$), ($t = 3.0469$, d.f. = 71, $p = 0.0032$), and had a longer mean carapace length (34.73 cm, range = 28.11 to 41.17 cm, $n = 34$ vs. 31.38 cm, range = 15.54 to 37.59, $n = 43$ respectively; $t = 3.4504$, d.f. = 75, $p = 0.0009$).

Using morphometric measurements to identify the sex is least reliable when applied to smaller males and juveniles, especially if their precloacal:posterior lobe ratios are in or near the region of overlap between the sexes (Mosimann and Bider, 1960). Of the six males for which there was a strong possibility of misidentifying the sex based on the intermediate precloacal:posterior lobe ratio, five (83.3%) extruded the penis. The other presumed male weighed 8.9 kgs and was heavier than all but three (2.3%) of 128 females caught, and thus probably was a male. We caught only three definite male juveniles, all of which were identified only through penis extrusion. The smallest juvenile that we were able to identify as male, at 1 kg, was the smallest juvenile caught. There was one juvenile of unknown sex. The rocking technique is probably the most reliable non-invasive method of identifying males with small precloacal:posterior lobe ratios, and it is the only known method of identifying juvenile males from external morphology alone.

We are unaware of any detailed published reports of descriptions of non-sexual penis extrusion in turtles, although undoubtedly this behavior has been observed by many individuals who have handled turtles. We have also observed penis extrusion by snapping turtles during handling from Lake Sasajewun (45°35'N, 78°30'W) in Algonquin Park, Ontario (RJB, unpubl. data) and Jack Lake (44°42'N, 78°02'W), Ontario (SRdS, unpubl. data). Penis extrusion during handling has also been noted in captive red-ear sliders (*Trachemys scripta elegans*, RJB, unpubl. data), captive painted turtles (*Chrysemys picta*, E. Matthews, *pers. comm.*), free-ranging spotted turtles (*Clemmys guttata*) and common musk turtles (*Sternotherus odoratus*) in Georgian Bay, Ontario, (J. Litzgus and J. Edmonds, *pers. comm.*), and free-ranging wood turtles in Algonquin Park (*Clemmys insculpta*, K. Smith, *pers. comm.*). Male painted turtles were never observed extruding the penis when handled either during our study at Cootes Paradise ($n > 100$ individual males) or at Wolf Howl Pond in Algonquin Park ($n = 32$ males, > 200 recaptures in 1995–96, N. Koper, *pers. comm.*). However, in the summer of 1998 in Algonquin Park, some painted turtles were induced to extrude the penis by rocking them, as described above (R. Van Vlaenderen, *pers. comm.*).

There have been three reported cases of snakes using defensive hemipenis displays: two in the South American coral snake (*Micrurus frontalis*, Allen, 1940; Azevedo, 1960), and the third in the Kukri snake (*Oligodon cyclurus*, Würster and Cox, 1992), although tail displays not involving the hemipenes are more common (see Greene, 1973). A number of hypotheses have been offered to explain extrusion of the penis in captured male snakes: 1) extrusion is a decoy that directs attention towards a less vital area (Carpen-

ter and Ferguson, 1977), 2) it is an aposematic display to warn predators (Carpenter and Ferguson, 1977; Würster and Cox, 1992), 3) it is a "flash display" which is used to startle potential predators, allowing the animal to escape, 4) it is an epiphenomenon of fright (Greene 1988), 5) it is used as a mimic of stingers for defense (Allen, 1940; Azevedo, 1960), 6) it is a physiological consequence of shunting blood away from the extremities in conjunction with holding the animal in an unnatural position, or 7) it is a displaced behavior that is incidentally displayed in an inappropriate situation.

There is little reason to believe that penis displays in snapping turtles are used to deter predators, and so this behavior is probably nonfunctional in the present context. Penis extrusion and agonistic displays appear to be linked; i.e., rocking the turtle increased the incidence of other agonistic behaviors of the turtle as well. Exposure to predator or conspecific aggression may lead to changes in blood pressure due to stress, by shunting blood from the extremities to the core of the body. A possible consequence of this is that abnormally high blood pressure may develop in the reproductive organs, and so when the turtle is held vertically with the tail towards the ground, the penis becomes erect and protrudes from the cloaca. However, to extrude the penis, the ventral portion of the tail between the plastron and the cloaca must be shortened by contracting the muscles on the ventral side of the tail. This posture is similar to the defensive stance when snapping turtles are threatened on land, where the turtle lowers the front and raises the rear of the carapace (Dodd and Brodie, 1975). The tail is bent ventrally and is used to brace the turtle as the rear of the turtle is raised. However, we have not observed males extruding the penis in this position.

The most likely explanation is that penis display is a displacement behavior. Displacement behaviors are behavior patterns that are "apparently irrelevant" to the current activity (Tinbergen, 1952; Zeigler, 1964). Displacement behavior generally occurs in conflict situations, when two conflicting goals are present simultaneously, or through "frustration," when an animal is unable to attain its goal (Tinbergen, 1952; McFarland, 1966). Stereotypic behavior is common in reptiles (see Carpenter and Ferguson, 1977), and the combination of aggression in the male turtle with an unusual body position may result in an inappropriate response. Male snapping turtles are known to use forced copulation to obtain matings (Berry and Shine, 1980), and mating takes place with the male on top in a partially inclined position (Carpenter and Ferguson, 1977). Holding a male turtle in a similar position while the turtle is aggressive may produce a partial mating response.

It should be clear that the cause of penis displays in turtles is unknown, and the incidence of this behavior varies among species. We suggest that the most likely explanation for our observations is that penis display is a displacement behavior. Regardless, the rocking technique outlined in this study is a useful technique to identify males, particularly large juvenile males, which are difficult to identify otherwise.

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LITERATURE CITED

ALLEN, C.E. 1940. Behavior of *Micrurus frontalis frontalis*. Copeia 1940: 51-52.

AZEVEDO, A.C.P. 1960. Notes on coral snakes (I-II). No. II. A new observation on the behavior of *Micrurus frontalis multicinctus* and its relationship with folklore. Iheringia 14:11-13.

BERRY, J.F. AND SHINE, R. 1980. Sexual size dimorphism and sexual selection in turtles (Order Testudines). Oecologia 44:185-191.

CARPENTER, C.C. AND FERGUSON, G.W. 1977. Variation and evolution of stereotyped behavior in reptiles. In: Gans, C. and Tinkle, D.W. (Eds.). Biology of the Reptilia, Vol 7. Ecology and Behavior A. New York: Academic Press, pp. 335-554.

DE SOLLA, S.R., BISHOP, C.A., VAN DER KRAAK, G., AND BROOKS, R.J. 1998. Impact of organochlorine contamination on levels of sex hormones and external morphology of common snapping turtles (*Chelydra serpentina serpentina*) in Ontario, Canada. Environ. Health. Perspect. 106:253-260.

DODD, C.K., JR. AND BRODIE, E.D., Jr. 1975. Notes on the defensive behavior of the snapping turtle, *Chelydra serpentina*. Herpetologica 31:286-288.

GALBRAITH, D.A., BISHOP, C.A., BROOKS, R.J., SIMSER, W.L., AND LAMPMAN, K.P. 1988. Factors affecting the density of populations of common snapping turtles (*Chelydra serpentina serpentina*) Can. J. Zool. 66:1233-1240.

GREENE, H.W. 1973. Defensive tail display by snakes and amphisbaenians. J. Herpetol. 7:143-161.

GREENE, H.W. 1988. Antipredator mechanisms in reptiles. In: Gans, C. and Huey, R.B. (Eds.). Biology of the Reptilia, Vol. 16. Ecology B: Defense and Life History. New York: Alan R. Liss, pp. 1-152.

MCFARLAND, D. 1966. On the causal and functional significance of displacement activities. Z. Tierpsychol. 23:217-235.

MOSIMANN, J.E. AND BIDER, J.R. 1960. Variation, sexual dimorphism, and maturity in a Quebec population of the common snapping turtle, *Chelydra serpentina*. Can. J. Zool. 38:19-38.

TINBERGEN, N. 1952. "Derived activities"; their causation, biological significance, origin, and emancipation during evolution. Q. Rev. Biol. 27:1-32.

WÜRSTER, W. AND COX, M.J. 1992. Defensive hemipenis display in the Kukri snake *Oligodon cyclurus*. J. Herpetol. 26:238-241.

ZEIGLER, H.P. 1964. Displacement activity and motivational theory: a case study in the history of ethology. Psychol. Bull. 61:362-376.

ZUG, G.R. 1966. The penial morphology and the relationships of cryptodiran turtles. Occ. Papers. Mus. Zool. Univ. Mich. 647:1-24.

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