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Curly-tail Malformity in Hatchlings of the Alligator Snapping Turtle, *Macroclemys temminckii* (Testudines: Chelydridae), from Northeastern Arkansas

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Despite several recent studies which advanced our knowledge on the biology of the alligator snapping turtle, *Macroclemys temminckii* (Harrel et al., 1996; Trauth et al., 1998; Tucker and Sloan, 1997), substantial information is still lacking, especially in the areas of hatchling development and ecology. In Arkansas, commercial harvesting of alligator snapping turtles has been prohibited by the Arkansas Game and Fish Commission since 1993 (Buhlmann, 1993); yet, at least nine turtle farmers have permits to rear this species. While visiting one of these farms (Pearrow/Jones turtle hatchery) near Batesville on 27 August 1999, we were shown three deformed hatchling *M. temminickii*. The hatchlings' tails were fixed in a tight spiral or coiled orientation; the unusual morphology (Fig. 1) was coined "squiggly-tail" by one of the local farmers.

Pritchard (1989) described and illustrated several deformities found in alligator snapping turtles (e.g., hunchback), but he did not mention any type of tail deformity. Unreferenced malformities similar to the curly-tail condition were described briefly by Ewert (1979) in emydids and were documented by Ryan (1986) in Blanding's turtle, *Emydoidea blandingi*; by Kar and Bustard (1982) in the saltwater crocodile, *Crocodylus porosus*, and by Green (1966) in the house mouse, *Mus musculus*. Ewert (1979) also mentioned bent-tails in the turtle families Chelydridae and Emydidae. Bent-tails have been further reported in the blacktail rattlesnake, *Crotalus molossus* (Smith et al., 1985). Acaudal phenotypes of the common snapping turtle, *Chelydra serpentina*, have been reported by Finkler and Claussen (1997). Thus, our observation appears to be the first account to provide details on curly-tail in *M. temminckii*.

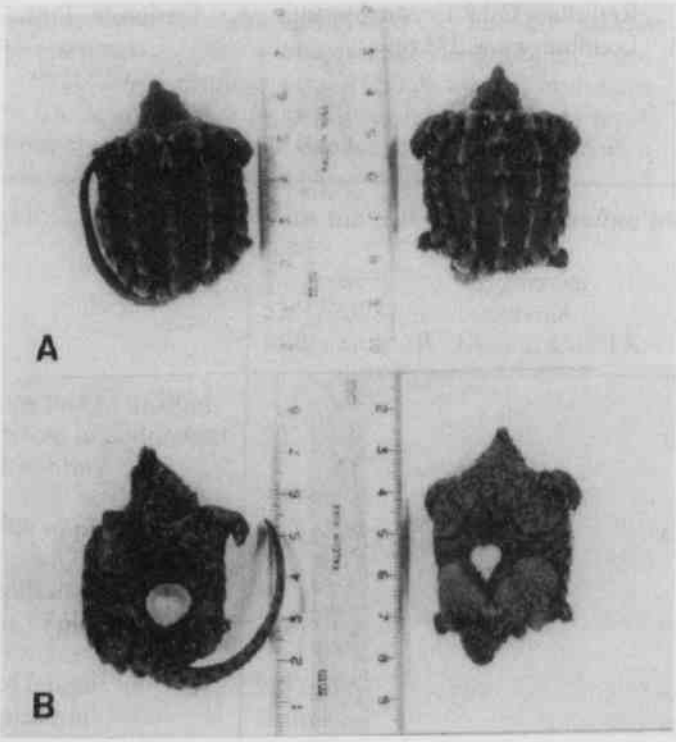

Fig. 1. A. Dorsal view of a normal (left) and curly-tail hatchling (right) of *Macroclemys temminckii*. B. Ventral view of the same hatchlings (as shown in A). The yolk plugs are visible in both hatchlings.

According to Mrs. Sandy Jones (caretaker of the turtle farm), about 10 instances of this deformity occur each year among 3,000 or so hatchlings at the hatchery. Turtle eggs are annually collected from the farm's nesting beach from June through July. The eggs are then transported to a nearby hatchery building and routinely incubated between 29.4° C and 32.0° C in air-tight plastic containers. Mrs. Jones indicated that at temperatures exceeding 36° C, the eggs die, whereas Pritchard (1989) indicated that *M. temminckii* eggs die at 39.4° C. Kar and Bustard (1982) suggested that tail malformities may result from unusually high incubation temperatures, while Yntema (1960) showed that unusually low incubation temperatures could result in reduced *C. serpentina* tails. Singh and Sagar (1991) found that 7 of 19 (36%) hatchlings of the Indian mugger, *Crocodylus palustris*, had bent or curled tails when incubated for a prolonged period under natural conditions due to higher incidences of rainy days and severe daily fluctuations in both temperature and humidity. Lynn and Ullrich (1950) further portrayed low humidity as a teratogenic factor in similar deformities. The alligator snapping turtle eggs had been packed in a moistened vermiculite substrate so humidity problems are an unlikely cause in the present scenario. Our hatchlings were returned to the laboratory and held in a plastic egg container for three days while they absorbed their yolk. They were then transferred to plastic containers containing 2 - 3 cm of water.

Ewert (1979) suggested that curly-tails may snag on objects as the hatchlings move about. Normal *M. temminckii* and *C. serpentina* may use the tail as a prehensile organ for

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anchoring themselves to objects on the river bottom (Brode, 1958). Curly-tailed hatchlings do not appear to possess a prehensile tail. Without its use, curly-tailed hatchlings and juveniles could easily wash downstream in swift currents where they might be more subject to predation or possibly drowning.

The curly-tail may reduce a turtle's reproductive success. Evidence suggests that the tail is used to pack dirt in the nest (Powders, 1978) and to support the female during nest excavation (Ewert, 1976). Without proper nest building skills, the female's nest may be easier for predators to find. Improper nest building could also expose the developing eggs to improper temperature and humidity. A normal tail is also essential for proper copulation (Berry and Shine, 1980).

Phenotypically acaudal juvenile *C. serpentina* required significantly more time to right themselves than did normal nest mates (Finkler and Claussen, 1997). These acaudal turtles could lift only the cranial portions of the shell. Normal individuals used both the head and the tail to flip over by lifting both the cranial and caudal ends of the shell. Curly-tailed *M. temminckii* appeared to have difficulty righting themselves; in fact, one individual was flipped over when we were initially shown them by Mrs. Jones. Curly-tailed individuals appeared unable to lift the caudal end of the shell off the substrate which appeared to contribute to their inefficiency in rolling over. Finkler and Claussen (1997) pointed out that a turtle resting on its carapace is much more susceptible to injury from predators than is a turtle resting on its plastron. They neglect to mention that flipped-over turtles that cannot right themselves are more likely to desiccate in the hot sun, or drown in shallow water.

The acaudal phenotype also compromises *C. serpentina's* ability to navigate up and down slopes (Finkler and Claussen, 1997). It is, therefore, probable that similar costs are incurred by curly-tailed *M. temminckii*. Navigation over slopes is essential for hatchling turtles finding their way to the water since water bodies are typically situated down slope from the nest and sometimes on the opposite side of a berm.

Although it is unlikely that many curly-tailed hatchlings would survive in the wild, one *M. temminckii* (unknown size) exhibiting this abnormality was reportedly observed by a local turtle trapper (Marshall Jones, pers. comm.). Survival of curly-tailed turtles would require hatchlings to exit the nest without getting entangled on eggshells, navigate down slope to the water without turning over and succumbing to predators, the sun, or drowning, and then avoid getting their tails caught on twigs and vegetation both in terrestrial and aquatic habitats. We speculate that most wild curly-tailed individuals succumb to predation before they ever enter the water.

The normal hatchling (carapace length = 37.8 mm; postanal tail length = 51.4 mm, weight = 15.97 g) and curly-tailed specimen (carapace length = 35.8 mm, weight = 15.3 g; post-anal tail length was unobtainable as the tail could not be forcibly unwound) shown in Fig. 1 are housed in the Arkansas State University Herpetology Collection (ASUMZ 23211-12).

We thank Marshall and Sandy Jones, co-owners of the Pearrow/Jones turtle farm, for allowing us to tour their facilities and for providing us with the hatchling specimens. Specimens were obtained under authorization by the Arkansas Game and Fish Commission (scientific collection permit no. 34 issued to SET).

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