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### Putative Chipmunk Predation of Juvenile Eastern Box Turtles

WILLIAM R. BELZER<sup>1\*</sup>, SUSAN SEIBERT<sup>2</sup>, AND BENJAMIN ATKINSON<sup>3</sup>

<sup>1</sup> Biology Dept., Clarion University/Venango Campus, 1801 West First Street, Oil City, PA 16301

<sup>2</sup> RD #1 Box 165-A-1, Utica, PA 16362

<sup>3</sup> c/o Biology Dept., Slippery Rock University, Slippery Rock, PA 16057

\*author to whom inquiries should be directed

Despite the protection of a strong shell, adult box turtles (*Terrapene*) are still sometimes killed by larger predators like raccoons, canids and felids (Zeiller, 1994). Hatchlings and small juvenile turtles, on the other hand, are extremely vulnerable to predation, serving as food for a great variety of small and larger animals, including birds, rodents and reptiles (Harless & Morlock, 1989).

Hatchlings are approximately 25 mm in diameter and the unossified, pliable shell poses no significant deterrent to even small predators. Predation on hatchlings and small juveniles is very high (Madden, 1975). However, Yahner (1974) and Murphy (1976) report that once juvenile box turtles attain a body weight of about 250-300 g, they suffer no greater mortality from predation than do adults (500 g).

In connection with our repatriation studies on eastern box turtles (*T. carolina carolina*) (Belzer, 1996 & 1999), we studied the survivability of yearlings (following an indoor "headstart" of five months' feeding at 75° F and 4 months' hibernation at 40°F). We released the yearlings into a protective 10 m x 6 m nursery (screened top and sides, but not underground, with heavy welded 2.5 cm x 5 cm wire mesh), with an inner fabric liner, for acclimation to natural habitat.

Our first two box turtle yearlings (released June 1997) were evidently eaten by a skunk (*Mephitis mephitis*) in August 1997. Skunk footprints were on the inner lining of the holding pen's walls the day we discovered the yearlings missing. The predator must have squeezed through junctures in the screening, as there were no burrows under the 30 cm deep subterranean walls.

After that predation episode, the enclosure was reinforced with a complete second barrier of heavy wire mesh (top and sides), plus a 3-strand solar powered perimeter of electrified fencing. Once the electrified barrier was in operation, we never again found evidence of larger predators, like skunks, having entered the enclosure, but chipmunks (plus, probably, other small rodents), and moles, frequented the inside of the pen. The added layers of protection enabled subsequent years' juveniles to survive in the nursery through 1998 and 1999.

On April 15, 2000, one of us (S.S.) paid a morning visit to the nursery and found a two year old juvenile (60 mm L x 50 mm W, approximately 30 g) on its back, with 20% of its plastron chewed open (Fig 1). Her approach chased off the

predator early in its attack. The hatchling was still alive and kicking even though its peritoneum was breached and intestinal tract and heart exposed. It survived, albeit with deteriorating vitality, through the ensuing 24 hours, till euthanasia was performed.

We did not observe the assault in progress. But of the potential small predators that could enter the enclosure, the chipmunk (*Tamias striatus*) was almost certainly the agent of this attack given daylight onset, size of the plastron wound, and relatively large tooth marks. Shrews, too, are known to chew open the plastron of hatchlings, but their mode of attack involves first chewing off feet, and some degree of paralysis of the victim (Zeiller, 1994).

More attacked young were found following the April 15 episode. For example, on April 17, 2000, another morning assault of a small, just-emerged, four-year-old juvenile (70 mm L x 60 mm W; approximately 45 g) was interrupted.

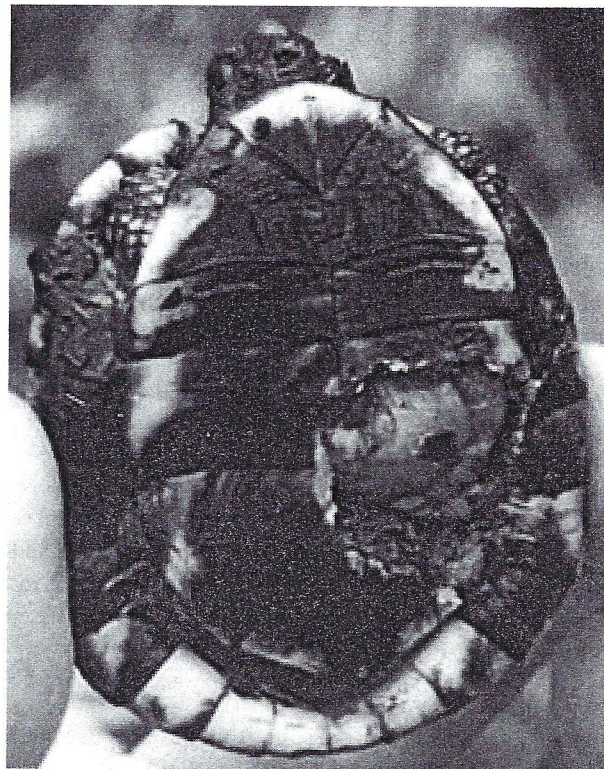


Figure 1. 20% of the plastron has been chewed open.

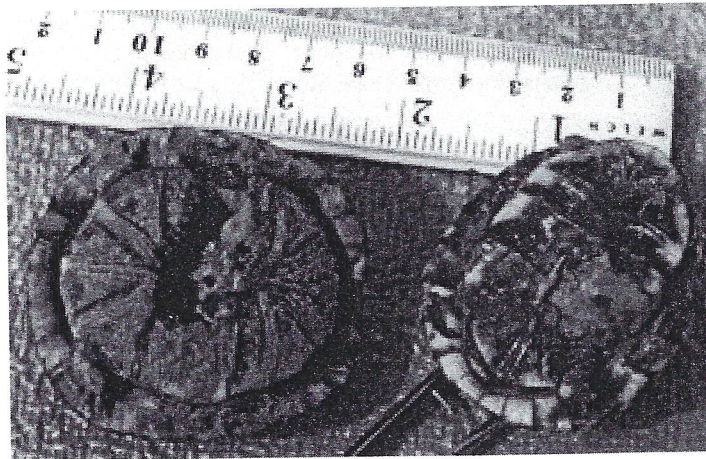


Figure 2. Gnawed on juvenile box turtles.

Again, the juvenile was on its back, with plastron partially gnawed open as in the April 15 case, but some viscera had been eaten and the turtle was already dead. The carapace of a two-year-old was later found with its entire plastron and all viscera gone. Evidently, after a couple of years' residency by juvenile turtles, the nursery was discovered to be a source of novel food by small predator(s) willing to wait for babies emerging from the ground. We saw no evidence that the turtles were excavated from their hibernacula. Evidently, as the juveniles sluggishly climbed out of the ground, they were grasped, turned upside down and their plastrons gnawed open like a nut (Fig 2).

Although popularly regarded as herbivores, chipmunks can be aggressively carnivorous. They are known to attack small birds, field mice, worms, eggs, etc. (Hensch, 1970). Gabriel Sagard described their "swarming" over, and devouring, fish that were left to dry on river banks by 17th century Native North Americans (Hensch, 1970). Predation on small turtles by the chipmunk, therefore, is consistent with its other dietary fare. Almost certainly, all of our 13 juveniles (ten two-year, one three-year, and two four-year-olds) would have been eaten in spring 2000 had we not intervened, excavated the hibernacula and evacuated four surviving individuals (1 four-year-old and 3 two-year-olds).

Conservationists using chelonian juveniles need consider chipmunks among the small predators that attack young turtles. Heppell et al (1996) noted that headstarting is wasted effort if juveniles can not be protected from predators till they reach sizes that confer significant defense against attack. Our experience reveals the mistake of omitting a subterranean floor for outdoor nurseries, and of using wire mesh that will not preclude smaller predators.

An alternative to constructing more elaborate nurseries (as developed by Morafka, Berry & Spangenberg, 1997) is to headstart juvenile box turtles until they reach the survivable size of about 275 g (Yahner, 1974; Murphy, 1976). Remarkably, this weight can be attained within two years using a careful, indoor, headstart protocol developed by Michell & Michell (1999). Kathy Michell guided our spring 2000 start-up of

their methodology, for our future studies of survivorship among larger juvenile headstarted box turtles. By one year, many of our juveniles are more than 100 g. One has already developed a functional hinge (K. Goodblood, pers. comm.)

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#### Acknowledgements

We thank Kathy Michell for kindly sharing information on improved headstarting and for patiently guiding our effort to emulate her success. We thank Robyn Graboski for evaluating feasibility of plastron reconstruction in small turtles, and for advice on proper euthanasia. We thank Jeff McFadden and Mark Bodamer for advice on designing multi-strand electrified perimeters. We thank Edwin G. Belzer, Jr, for suggestions on improving the writing style in successive drafts of this article.