

Short Communication

MUSK ODOR PRODUCTION IN HATCHLING THREE-TOED
BOX TURTLES (*TERRAPENE CAROLINA TRIUNGUIS*)

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ABSTRACT—Most species of aquatic turtles have integumentary exocrine glands associated with the bridge and variously referred to as Rathke's, musk, or scent glands. Rathke's glands have been found in *Terrapene* species. Waagen found one or two pairs of axillary musk glands in three of sixteen (19%) *T. carolina* specimens. During the year 1997, 1999, 2000, and 2001 we recorded observations of odor production by hatchling three-toed box turtles. Of 1,407 hatchlings examined, 315 (22.4%) produced a detectable odor. The hatchlings sampled came from 503 clutches laid by 60 different females. Overall, 41% of all clutches produced at least one hatchling in which an odor producing capability was recorded.

Key words: *Terrapene carolina triunguis*, Rathke's glands, musk glands.

INTRODUCTION

Most species of aquatic turtles have integumentary exocrine glands associated with the bridge and variously referred to as Rathke's, musk, or scent glands. Waagen (1972) reviewed the morphology and evolution of these glands, concluding that all the glands in turtles are homologous. Histologically, the glands have been shown to have the holocrine mode of secretion (Solomon 1994, Zangerl 1941). Seifert et al. (1994) summarized chemical studies of the gland's secretions. The function of the secretions is unknown, but several possibilities were discussed by Mason (1992), including predator deterrence and sex and species recognition.

Glandular secretions may be released when the turtle is disturbed (Neill 1948b, Legler 1960, Goode 1967), and several authors have reported that younger turtles seem to be more inclined to discharge secretions than adults (Neill 1948a, Waagen 1972, Kool 1981). Several authors have reported a foul smelling musk produced by box turtles of the genus *Terrapene* (Neill 1948a, Norris and Zweifel 1950), including both young and adult *T. ornata* (Legler 1960).

Rathke's glands have been found in *Terrapene* species, including *T. ornata*, *T. nelsoni*, *T. coahuila* and *T. carolina* (Hoffmann 1890, Legler 1960, Waagen 1972). Waagen (1972) found one or two pairs of axillary musk glands in three of sixteen (19%) *T. carolina* specimens. The glands in the shell of *Terrapene* had ducts passing through an osseous canal formed by the hyoplastral buttress and the third peripheral bone of the carapace. The



FIGURE 1. The location of the orifice of the duct of the Rathke's gland.

external, slit-like orifice of the duct lies in the vicinity of the sulcus along the inferior border of marginal scutes 3 and 4 (Fig. 1).

Neill (1948a) reported the production of an offensive odor by box turtle hatchlings in Richmond County, Georgia, corresponding with the Eastern Box Turtle, *T. c. carolina*. We wanted to determine if three-toed box turtle hatchlings, *T. c. triunguis*, also produced a musk odor.

MATERIALS AND METHODS

From 1990 through 1995, we handled three-toed box turtle hatchlings at our study site without noticing any odor (Messinger and Patton 1995). In 1996, we began to measure the carapace of hatchlings with calipers; as we did, they struggled vigorously and an occasional hatchling produced a strong odor. During the years 1997, 1999, 2000, and 2001 we recorded observations of odor production by hatchlings. For each hatchling, the presence or absence of odor, clutch, and mother were recorded.

RESULTS AND DISCUSSION

Over the four-year period, all hatchlings were handled in the process of taking measurements. They often struggled while being held and this is when the odor from the glandular discharge was noticed. This timing would seem to lend support to the hypothesis that the secretion serves a defensive function.

TABLE 1. Odor production by hatchling three-toed box turtles. OPH = odor producing hatchlings.

Year	Number of hatchlings	Number of OPH (% OPH)	Clutches containing		
			Number of clutches	OPH	Number of mothers
1997	206	34 (16.5%)	84	26.2%	20
1999	401	99 (24.7%)	133	51.1%	47
2000	360	100 (27.8%)	139	47.4%	46
2001	440	82 (18.6%)	147	36.7%	51
Total	1,407	315 (22.4%)	503	41.0%	60

Of 1,407 hatchlings examined, 315 (22.4%) produced a detectable odor (Table 1). The hatchlings sampled came from 503 clutches laid by 60 different females. Overall, 41% of all clutches produced at least one hatchling in which an odor producing capability was recorded.

For all females that produced at least 10 hatchlings, the percentage of odor producing hatchlings per female ranged from 4.2% to 53.8% with a modal range of 15–21% (Fig. 2).

Other than presence or absence of odor production, we made several other observations about the timing of the phenomenon. The youngest stage at which a musk odor was detected was in neonates that had pipped the eggshell, but prior to emergence of the hatchling. Although we have handled all life stages extensively, we have not detected odor discharge in any specimens other than hatchlings no more than a few days old.

Under the assumptions that musk odor production is indicative of the presence of Rathke's glands, and that we detected the odor producing capability when present, we can compare our results with the observations by Waagen (1972). He found the glands in 19% of the *T. carolina* he examined by dissection (presumably adults). Since we detected the presence of musk odor in 22.4% of box turtle hatchlings examined, we expect that only about 22% of *T. c. triunguis* hatchlings have Rathke's glands, and that the glands do not completely degenerate as the turtles grow older, but do apparently become inactive.

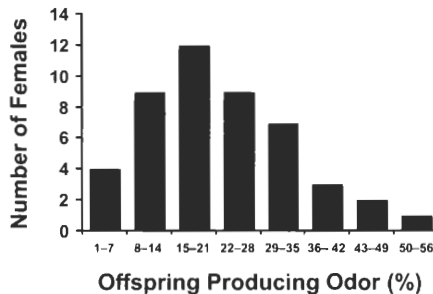


FIGURE 2. The percentage of odor producing hatchlings produced by various females.

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