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Multiple Clutches and Nesting Behavior in the Gulf Coast Box Turtle

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Although many North American emydid turtles typically lay more than one clutch of eggs per year, this does not appear to be generally true of the eastern box turtle (*Terrapene carolina*), whose range encompasses much of the eastern United States. However, Dickson (1953) recorded annual production of as many as four clutches by captive female Florida box turtles (*T. c. baurii*) in southern Florida, and Legler (1958) noted the presence of two sets of corpora lutea in some females taken from peninsular Florida and southern Mississippi. Based on gonadal examinations, Tucker et al. (1978) postulated the routine occurrence of multiple clutches in a Florida panhandle population of the largest extant subspecies, the Gulf Coast box turtle (*T. c. major*). However, because follicular atresia as well as ovulation may produce corpora lutea, and because there is no assurance that enlarged and preovulatory follicles will be ovulated, direct observations of multiple nestings are needed to verify this phenomenon. In this paper I confirm the hypothesis of Tucker et al. (1979) via repeated observations of nesting by a single female Gulf Coast box turtle during a five-year period.,

On 18 February 1986 I acquired a pair (male and female) of adult Gulf Coast box turtles that had been collected two days earlier in floodwaters of the Ochlockonee River (T2N, R1W, sec 18), Leon/Gadsden County Line, Florida. Respective maximum carapacial/plastral lengths (mm, CL/PL) of the male and female were 178/171 and 160/160. The female showed no linear growth throughout the study; her non-gravid mass was about 730 g. Along with several other resident Gulf Coast and eastern (*T. c. carolina*) box turtles, both were allowed to roam freely in my fenced, 570 m^2 back yard, which consists predominantly of a mixed, mesophytic hardwood hammock in northern Leon County. In the southeast corner is a 30 m^2 barren to grassy area that slopes up to the hammock (maximum elevational difference = 40 cm). During heavy rains, the lower area is prone to brief flooding, with the soil remaining saturated for several days. A small artificial "pond" (33 cm diameter, 8 cm maximum depth) provides water. Bananas, tomatoes, and earthworms were offered occasionally to supplement naturally obtained food, which included mushrooms, invertebrates, and other organic matter.

Table 1. Observed clutches produced by female Gulf Coast box turtle (*Terrapene carolina major*), Leon/Gadsden County, Florida.

Date	No. of eggs	Mean egg mass (g)	Mean egg L (mm)	Mean egg W (mm)	H[1]	Days to pipping (°C)
12 Jul 1986	4	12.0	39.1	22.8	4	81-84 (23-27)
12 Jun 1987	4	11.3	38.0	22.5	2	68-70 (24-31)
5 Jul 1987	5	12.0	37.9	22.4	1	63 (23-31)
1 Aug 1987[2]	1	–	–	–	–	–
23 Jun 1988	5	11.9	39.2	22.8	0	– (24-29)
24 Jul 1988	4	11.1	38.3	22.2	1	69 (24-29)
25 Jun 1989	5	11.6	38.1	22.5	2	50 (33), 66 (27)
20 Jul 1989	4	–	38.5	21.9	0	– (1 at 27)
17 Aug 1989	3	–	40.1	21.8	0	– (27, 33)
11 Jun 1990	5	12.0	40.2	22.5	3	51-57 (30)
8 Jul 1990	3	11.3	38.0	22.4	2	82-84 (24-26)
2 Aug 1990	4	10.5	38.1	21.8	1	54 (30)

[1]H = number hatched from clutch.
[2]Date of X-ray, not of oviposition.

Since obtaining them, I have observed the male mounting the female in all months from March through October, with prolonged intromission occurring at least on 12 August 1988 and 1 June 1989. Although the male has mounted at least four other females, I have never recorded the female being mounted by any of the three other resident, sexually active males. Repeated observations of agonistic behavior by both individuals toward adults of their own sex as well as toward an immature individual clearly establish the pair as the dominant male and female.

I first observed the female nesting on 12 July 1986. During the following four years she produced at least two to three clutches annually from mid-June to mid-August. On 29 July 1987 she began nest construction but abandoned the effort, presumably because of insufficient soil moisture. An X-ray taken three days later revealed the presence of a single shelled egg. Table 1 summarizes data for all known clutches. It is possible that I failed to witness additional nestings during this period. Internesting intervals between observed nestings within years were 23, 30, 25, 28, 27, and 25 days.

Except in two instances when I artificially watered the area, all but three nestings occurred on days on which there had been substantial rainfall, usually following several dry days. The June 1989 nesting occurred on the first sunny day after two weeks of rainy weather (the wettest June on record for Tallahassee). The August 1989 and 1990 nestings each occurred one day after a heavy, late afternoon thunderstorm. Precipitation was well below normal in 1988 and 1990 but above normal in 1989. All nestings began near dusk (1730-1915 hr EST) and were completed after dark (from 2100-2300 hr EST). This pattern apparently is typical of the species (Ernst and Barbour 1972). The female was observed soaking in the pond for up to two hours daily on the days immediately preceding most nestings. Following nesting, she invariably lay "exhausted" above the nest for 1-2 hours, then walked directly to the pond, where she again soaked for 12-30 hours, much as noted by Dickson (1953) for Florida box turtles.

Nest site selection was remarkably invariant. Six of the 11 observed nest sites were within 10 cm of each other, at the base of a small sweetgum tree (*Liquidambar styraciflua*); a seventh was dug 1.5 m to the north, and the remaining 4 were within a few cm of

each other but 5 m north of the first site. All were just below the top of the slope and at the edge of the forest. Presumably this provides sufficient sunlight for incubation while concomitantly protecting the eggs from flooding. Stickel (1989) noted analogous nesting migrations from bottomlands to repeatedly used drier upland sites among a free-ranging population of eastern box turtles in Maryland.

I removed all eggs for measurement and subsequent incubation within 12 hours of nesting. Three of the four July 1989 eggs had been depredated from below ground and were swarming with ants; it was not determinable whether the ants themselves or possibly a small vertebrate (shrew tunnel present) had instigated the predation. Mean egg size (38.6 x 22.3 mm, n = 46; 11.6 g, n = 39) was only slightly larger than Gulf Coast box turtle eggs measured by Tucker et al. (1978: 37.8 x 21.3 mm, 11.2 g) and Ewert (1979: 38 x 22 mm) and likely reflects the relatively large size of the female (PL = 132-162 mm for females examined by Tucker et al. 1978). Likewise, hatchlings were correspondingly larger than those recorded by Tucker and Funk (1977). Mean hatchling measurements, recorded 10 to 20 days after pipping but before feeding, were 33.9 mm PL (28.5-38.8, n = 14), 35.9 mm CL (31.8-39.7, n = 14), and 9.5 g (8.3-11.3, n = 11).

The production of multiple annual clutches may be typical of this subspecies; at least three other experienced reptile keepers (Richard Bartlett, Mike Ewert, Joe Ward, pers. comm.) have advised me that female Gulf Coast box turtles in their care have laid more than one clutch per season. These data, therefore, corroborate the anatomically based predictions of Tucker et al. (1978) and, in fact, exceed even their more liberal estimate of a female's annual reproductive potential (9.25 eggs). Though limited, the present data also suggest a general but inexact decline in clutch size throughout the season. This trend likewise appears to characterize other species of box turtles (*Terrapene coahuila*: Brown 1974; *T. ornata*: Legler 1960) in which at least some females are believed to lay more than one clutch annually.

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