

Terrestrial Foraging by Two Species of Semiaquatic Turtles (Testudines: Emydidae)

John L. Carr*

Abstract - I describe terrestrial foraging behavior in *Trachemys scripta elegans* (Red-eared Slider) and *Graptemys pseudogeographica kohnii* (Mississippi Map Turtle), two species of semiaquatic turtles. I observed specimens of Red-eared Slider on two occasions in two different locations climbing onto the bank of a stream and consuming grass blades (*Luziola fluitans* [Southern Watergrass] and *Eragrostis hypnoides* [Teal Lovegrass]), which were swallowed when the turtles returned to the water. These observations included both adult males and females. In addition, I observed on one occasion two juvenile Mississippi Map Turtles leave the water and forage on plants on a stream bank also used by Red-eared Sliders. Individuals of Mississippi Map Turtles passed by grass and consumed the sprouts of a dicot (*Ludwigia decurrens* [Wingleaf Waterprimrose] and/or *Pentodon pentandrus* [Hale's Pentodon]).

An elaborate categorization has been proposed by Gibbons et al. (1990) for the purposes of understanding the evolutionary significance of movement behaviors in turtles. Their system includes both a spatial and temporal component in which they recognize intrapopulational and extrapopulational movements that might vary in daily or seasonal timing. For a semiaquatic turtle such as *Trachemys scripta* Schoepff (Pond Slider), they considered a departure from the water into the terrestrial environment to be an extrapopulational movement. Feeding was considered one of the principal factors eliciting intrapopulational movements, while departing an unsuitable habitat and seeking new food resources were regarded as extrapopulational factors. To understand movement, they recommended quantification of direction, distance, and time within their categorical framework.

Feeding on land was not specifically mentioned with respect to terrestrial movement by aquatic or semiaquatic turtles (Gibbons 1970, Gibbons et al. 1990); however, there is at least one such report for a North American emydid. Cagle (1944) observed terrestrial grazing on grass by *Trachemys scripta elegans* Wied-Neuwied (Red-eared Slider) in Illinois, but he provided no details on the behavior. Although several studies of the Pond Slider and related taxa have reported grasses in the diet without indicating whether they were terrestrial or aquatic (see review in Parmenter and Avery 1990), only Moll and Legler (1971) have reported a specific taxon of grass, an aquatic *Paspalum* sp. (Crowngrass) eaten by Neotropical sliders in Panama. Parmenter and Avery (1990) discounted the significance of terrestrial plants in the diet of sliders, while acknowledging Cagle's observations. More recently, Lindeman (2000) reported both terrestrial monocots (such as grass) and dicots in the diet of Red-eared Slider and *Graptemys ouachitensis* Cagle (Ouachita Map Turtle) in western Kentucky; however, neither was found in the diet of *G. pseudogeographica* Gray (False Map Turtle) from the same locality. In this case, he attributed the presence of terrestrial plants in stomach contents to an inundated shoreline with rising water levels and leaf fall into the water (P.V. Lindemann, Edinboro University of Pennsylvania, Edinboro, PA, pers. comm.). Webb (1961) also found terrestrial plants in the stomach of a single adult female Ouachita Map Turtle from Lake Texoma, OK, but he also noted that the specimen was captured during a time of shoreline inundation and those plant species (*Cynodon dactylon* (L.) Pers. [Bermudagrass] and *Phyla nodiflora* (L.) Greene [Turkey Tangle Fogfruit]) were growing in low areas near the shoreline. Moll (1976) similarly reported terrestrial plants in the diet of a Mississippi River population of Ouachita Map Turtle and attributed the plants' presence to times of high water when shoreline areas were inundated, or to leaf and fruit that had fallen

into the water. For the closely related False Map Turtle, it appears the only report of a terrestrial plant in the diet is of *Vitis rotundifolia* Michx., Muscadine (Grape), a fruit very likely to drop into the water (Ernst et al. 1994, Shively and Vidrine 1984).

In this paper, I report two sets of field observations of terrestrial foraging involving the semiaquatic emydid turtles Red-eared Slider and *Graptemys pseudogeographica kohnii* Baur (Mississippi Map Turtle). Observations were made during a spotting-scope survey of river turtles. Plant collections and bank measurements were made after the observations. For each instance, I provide a description of the location and habitat, animals and plants involved, and the behavior observed. I refer to the turtles by number in the order observed during a set of observations.

Observation Set #1. I observed terrestrial foraging in Red-eared Slider on 6 August 1998 in Catahoula Parish, 15.6 km south of Jonesville (31°29'N, 91°49'W) on the east bank of a cove off the Black River, at the point where Black River Lake was created by cutting a navigation channel (Smithland Cutoff) across a loop in the river course. Observations were made from the opposite bank at a distance of ca. 125 m with a 60-mm zoom spotting scope (Bausch and Lomb, Rochester, NY) at 45x. Turtle # 1 was readily identifiable as a Red-eared Slider based on the presence of the wide, red postorbital stripe on the head, and as female based on the relatively small tail. Turtles #2 and #3 were similarly shaped emydid, but were primarily black as viewed through the spotting scope. Their shape and behavior with respect to the female suggested that they were melanistic male Red-eared Sliders; however, given the distance and failure to detect diagnostic markings, I cannot rule out the possibility that they may have been *Pseudemys concinna* LeConte (River Cooter). Turtle species observed basking in the cove during 2 h and 10 min of observation at this site included Red-eared Slider, River Cooter, and Mississippi Map Turtle.

Turtle #1 was walking in the shallow water near shore, then moved toward the bank and walked part way onto land amid some grass, following which it returned to the water with grass blades protruding from its mouth. On returning to the water, the turtle immersed its head and presumably swallowed, as no grass was visible when the head was again extended fully above the water. This individual repeated this behavior for 21 minutes, from 17:15 to 17:36 CDT, during which time at least one dozen bouts of grazing were observed as the turtle moved along an approximately 5-m section of bank with new grass growth. Each bout was similar: the turtle approached the bank, extended the neck and made up to 4 to 5 bites, then turned back toward the water and submerged just enough so that the head could be fully immersed for swallowing. On at least three of the grazing bouts, turtle #1 completely left the water and walked into the grass, but never farther than ca. 30 cm from the water line.

During the same time period, a similarly-sized turtle (#2) appeared beside #1 and seemed to follow turtle #1 in the shallow water. As #1 moved toward shore to graze and then turned around to swallow, #2 moved so as to remain in close proximity. After several minutes, turtle #2 also began to graze. Four or 5 bouts of grazing by turtle #2 were observed, but it never completely left the water to do so—it either remained in the water right at the water line and reached what it could from there or, at the most, its forefeet and anterior shell were out of the water. In each case, it took several bites, then turned and submerged in the water deep enough to swallow.

Later, turtle #3 appeared and remained in close proximity to the first two turtles in shallow water, adjusting its position during the time when #1 and #2 were grazing and swallowing. I observed #3 make only one grazing bout.

The bank section that turtle #1 grazed supported predominantly one species of grass (*Luziola fluitans* (Michx.) Terrell & H. Robins. [Southern Watergrass]), which consisted mostly of young, green shoots sprouting at and above the water line. At some points, the grassy strip was as wide as 35 to 40 cm. Near the middle of the

length of the grassy strip was an area of very gentle slope where the grass appeared to have been shorn in a swath about 8 to 10 cm wide and 1.5 to 2 m long immediately adjacent to the water's edge. On the up-bank side of this strip of short grass, the grass blades were mostly 8+ cm longer. Adjacent to the shore, I found new and old grass blades that were cut (i.e., bitten off). The upper littoral zone exhibited a shallow shelf ca. 0.5 to 0.75 m wide with a sandy bottom adjacent to the water line and lacked submerged, floating, and emergent aquatic plants.

Observation Set #2. I again observed terrestrial foraging by semiaquatic turtles on 5 August 2000 in Morehouse Parish on the east bank of Bayou Bartholomew at the Highway 591 bridge crossing 18.7 km NNE of Bastrop (32°55'N, 91°48'W). I watched the turtles from the bridge deck at a distance of approximately 75 m with a 70-mm spotting scope at 60x magnification. Only 2 turtle species were observed at this site during 2 h and 25 min of observation: Red-eared Slider and Mississippi Map Turtle.

Observation of an adult female Red-eared Slider (TSE #1) on a grassy bank of the bayou began at 16:48 CDT. She took 4 or 5 bites of grass before returning to the water. After swallowing in the water, she ascended the bank again and made several biting motions before I lost sight of her when she was ca. 1.4 m from the water.

Later, between 17:58 and 18:12 h, two other Red-eared Slider specimens (TSE #2 and #3) were seen in shallow water just off the bank. TSE #2 was never observed to leave the water or graze, but TSE #3 was a melanistic male that did both. He climbed onto the bank at 18:01 h and took at least 5 bites, including an unsuccessful one in the direction of a green caterpillar climbing on a stick, before returning to the water with a blade of grass protruding from the mouth (total trip time on land = 145 sec). The grass blade floated away as it entered the water, but he caught up to it and swallowed it. TSE #3 made one other trip onto the bank, and then returned to the water within a minute.

While TSE #1 was on the bank, I noticed two juvenile Mississippi Map Turtles (GPK #1 and #2) near the same bank, later joined by a third (GPK #3). GPK #2 had its front feet in the mud at the base of the bank and its hindfeet in the water, but shortly thereafter it was basking on a branch where it stayed for over an hour. GPK #1 and #3 were observed completely out of the water on the bank foraging during a 1 h 20 min period. Initially, GPK #1 moved between the near shore shallows and slightly deeper water repeatedly. Once it only emerged with the forefeet on the bank, then backed into the water rather than turning around. Finally it went onto the bank, took at least two bites, then quickly returned to the water with a dicot leaf hanging from its mouth. GPK #3 appeared in the shallow water and shortly thereafter started making foraging forays onto the bank. At 17:15 h was the first time that both GPK #1 and #3 were on the bank at the same time; each took a single bite of a plant, then returned to the water and swallowed. The two were in close proximity to one another, closer than necessitated by the size of the bank. Between 17:15 and 18:09 h, these two map turtles made a combined total of at least 29 foraging trips onto the bank, of which I noted 9 successful trips and 4 unsuccessful trips, i.e., when biting motions were made but the turtle returned to the water without any plants protruding from the mouth. Only 1 or 2 bites per foray were recorded for the Mississippi Map Turtles, and mean duration out of the water for 6 timed forays was 76 sec (1 SD = 37.3, range 29–115). The two were often on the bank at the same time, and at least some of the foraging trips extended as far up the bank as approximately 0.5 m from the water line. They were selective with respect to the vegetation available on the bank—they passed grass and selected leaves of a broad-leaved plant. On a successful trip with a leaf protruding from the mouth, the turtle would usually return to the water quickly for swallowing, i.e., make a fast scamper or scramble to the water.

The bank where the turtles were feeding had a very gentle slope and extended for a distance of 3.6 m along the bayou. The substrate in the upper littoral zone was

a silty sand, and lacked submerged, floating, and emergent aquatic plants. On the bank immediately adjacent to the water's edge was a muddy, silt-covered zone that varied between 25 and 30 cm wide. The vegetated zone extended up the bank from the muddy zone to the full extent of the bank, a maximum of 2.7 m. There were scattered, small dicotyledonous plant sprouts in the muddy zone, above which the bank exhibited a more densely vegetated zone predominated by grass. There was a single dominant grass in the vegetated zone (*Eragrostis hypnoides* (Lam.) B. S. P. [Teal Lovegrass]), the species inferred to have been eaten by the 2 Red-eared Sliders. Scattered individuals of the dicot sprouts were also present in the grassy, vegetated zone. Two species of dicot sprouts from the region of the bank frequented by the map turtles were identified: *Ludwigia decurrens* Walt. (Wingleaf Primrose-willow) and *Pentodon pentandrus* (K. Schum.) Vatke (Hale's Pentodon). At the time they were being consumed, all sprouts had only the cotyledons, or cotyledons plus one pair of leaves. It was not possible to ascertain which of these species was the dicot eaten by the map turtles, so both are considered food items.

Discussion. Tucker (1958) described the correlation between extent of salivary gland development and ecology of various vertebrates, in particular birds and mammals. In general, variation from poorly to well-developed salivary glands occurs across taxa from aquatic carnivores to terrestrial herbivores. In a survey of morphology of salivary glands and the epithelial surface in the buccopharyngeal cavity of turtles, Winokur (1988) was able to relate anatomy to diet and habitat. He placed most of the Emydidae, including *Trachemys* and *Graptemys*, in a morphologically generalized group composed predominantly of semiaquatic and aquatic omnivores, including species both capable and incapable of swallowing out of the water. However, there was no simple correlation of swallowing capability with a specific morphology of tongue papillae or mucous (salivary) glands, and he suggested this capability may be related to the musculature of the region, which varies phylogenetically. Cahn (1937) commented that captive specimens of False Map Turtles would only feed while submerged, not while on land. My observations indicate that both the Red-eared Slider and Mississippi Map Turtle will ingest food items on land, but they return to the water and submerge their heads before swallowing.

These observations are significant in that details of terrestrial foraging behavior in 2 turtle species are described, corroborating the observations of Cagle (1944) for the Red-eared Slider, and highlighting this as a new source of allochthonous input to aquatic ecosystems by semiaquatic turtles. In addition, specific taxa of terrestrial forage plants have been identified. Given this limited set of observations, there are nonetheless several aspects of the behavior that raise intriguing questions. Both observation sets involved multiple individuals within sight of one another, in one instance involving 2 different species, suggesting the possibility of social facilitation in terrestrial emergence and feeding, something akin to the enhanced food intake reported in social feeding trials with *Pseudemys nelsoni* Carr (Florida Red-bellied Cooter) (Bjorndal 1986). There were also specific aspects of terrestrial foraging behavior that differed between the 2 microsympatric taxa that might warrant additional study: 1) life stage engaged in foraging: adults of both sexes in Red-eared Slider, and juveniles in Mississippi Map Turtle; 2) type of plants: grasses in Red-eared Slider, and dicots in Mississippi Map Turtle; 3) number of bites made and success in obtaining vegetation during foraging bouts: 4 or 5 in Red-eared Slider with 100% success vs. 1 or 2 with ca. 70% success in Mississippi Map Turtle; and 4) the maximum time spent out of the water and distance traveled from the shoreline: >2 min and 1.4 m in Red-eared Slider vs. <2 min and 0.5 m in Mississippi Map Turtle.

Foraging, though apparently infrequent, must be added to the list of behavioral activities for which terrestrial movements in emydid turtles have been documented

(Gibbons 1970, Gibbons et al. 1990). In both instances reported here, the turtles were foraging on new plant growth that had sprouted along the shore after the water level fell towards the end of the summer, which is the normal hydrologic cycle. This sort of movement would fit within the conceptual framework of Gibbons et al. (1990) as an extrapopulational movement to seek a new food resource, even though the distance traveled into the terrestrial environment was not far and the turtles returned immediately to their water body of origin. Thorough understanding of this behavior will require additional careful observation of individuals in their natural habitat.

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*Department of Biology and Museum of Natural History, University of Louisiana at Monroe, Monroe, LA 71209-0520; carr@ulm.edu.