

**BEHAVIOR OF
HATCHLING DIAMOND-
BACK TERRAPINS
(*Malaclemys terrapin*)
RELEASED IN A SOUTH
CAROLINA SALT MARSH**

Aspects of the ecology and demography of diamondback terrapins (*Malaclemys terrapin*) have been published for populations in Delaware (Hurd et al. 1979), New Jersey (Montevecchi and Burger 1975), Florida (Seigel 1984), South Carolina (Lovich and Gibbons 1990), and Louisiana (Cagle 1952). However, as in most turtle species, very little is known regarding the behavior and ecology of juveniles. Studies of reproductive ecology (Burger 1976, 1977; Burger and Montevecchi 1975; Montevecchi and Burger 1975; Seigel 1980) and hatchling emergence behavior (Burger 1976) have documented the first few weeks of a terrapin's life, but from the time that a hatchling enters the water to approximately the time of sexual maturity, little is known about wild *M. terrapin*.

We have studied a population of *M. terrapin* in Charleston Co., South Carolina since 1983 (Lovich and Gibbons 1990). Like previous investigators (Coker 1906; Hurd et al. 1979) we were intrigued by the

absence of hatchling and juvenile terrapins (0-3 yrs of age) in our sample of over 670 marked individuals, despite repeated efforts to locate them using a variety of collecting techniques.

The objective in this study was to observe the behavior of artificially incubated *M. terrapin* following release into the wild. It was hoped that their behavior would provide clues as to where these animals spend their first few months of life after leaving the nest.

MATERIALS AND METHODS

Nineteen eggs were removed from three *Malaclemys terrapin* nests on Kiawah Island, South Carolina on 21 May 1990. The nests were located on exposed sand dunes with sparse vegetative cover (*Uniola paniculata*) along the Kiawah River. The eggs were returned to the Savannah River Ecology Laboratory (SREL) for incubation at either 27° or 30°C as part of a larger study of terrapin ecology (see Lovich and Gibbons 1990). Eight eggs hatched in late July, 1990. The hatchlings were maintained in an aquarium at SREL, unfed due to the presence of large yolk sacs, for one week prior to being released on Kiawah Island. The mean straightline carapace length (CL) of the hatchlings was 33.4 mm (SD = 1.5 mm, range 32-36 mm). A single individual (36 mm CL) from a clutch hatched in October of the previous year was included in the experiment.

The nine hatchlings were released on 22 August in the salt marsh across the Kiawah River from the nest sites. The release points were located along the shoreline of a small (600 m²) island in the marsh known to have concentrated nesting activity. The island sustains a few pines (*Pinus taeda*), live oaks (*Quercus virginiana*) and palmettos (*Sabal palmetto*), but a dense cover of *Spartina patens* predominates. The marsh around the island is composed of dense to sparse stands of *Spartina alterniflora* that are exposed at low tide. The habitat around the immediate perimeter of the island where the hatchlings were released is the "short *Spartina* high marsh / *Salicornia*—*Distichlis* marsh" described by Teal (1958). The behavior of each hatchling was monitored by a pair of observers for one hour after being released in the water within 1-2 m of the shoreline or on the island. Releases occurred at 1200 h.

RESULTS

All hatchlings displayed a general avoidance reaction to open water and

swam toward shoreline vegetation even when observers were standing on the shoreline in direct view of the animals. The orientation of release, relative to the sun, did not appear to influence this behavior; hatchlings swam toward shore when released on both north and south sides of the island. In addition, upon encountering beached mats of tidal wrack (*Spartina* stems) terrapins immediately burrowed into the mat by pushing the stems apart with their forelimbs. This behavior was remarkably consistent and was repeated by the same animal even when it was pulled out of the mat and allowed to choose again between burrowing and some alternative behavior. Hatchlings released facing away from the island also turned and swam directly toward the shoreline. Hatchlings released on the island within one meter of the line of tidal wrack moved in the direction of the wrack and burrowed. Burrowing behavior always occurred in the tidal wrack at the high tide line. No terrapins were observed to venture beyond this microhabitat into the dry interior of the island.

DISCUSSION

Most hatchling *Malaclemys terrapin* emerge from the nest during the daytime, 1-9 days after hatching (Burger 1977) and move toward the closest terrestrial vegetation. This behavior is consistent regardless of the direction of incline in the terrain (Burger 1976). The apparent negative phototaxis exhibited by this species following emergence may be selected for because of high diurnal predation by shore birds (Burger 1976). In contrast, several other turtle species exhibit positive phototaxis (Anderson 1958), heading straight for the water following emergence from the nest. After entering the water terrapins are rarely seen until they attain sexual maturity some 3-6 yrs later (Lovich and Gibbons 1990).

The only published information on the microhabitat of juvenile *M. terrapin* during the active season is given by Pitler (1985). He observed juveniles with shell lengths ranging from 25-75 mm hiding under "accumulated surface debris and matted *Spartina* grass" in a New Jersey "tidal mud flat." He made 12 observations between 30 May 1979 and October, 1981. Several observations were made of terrapins hiding under rocks, boards, and a low growing *Vaccinium* bush. Lawler and Musick (1972) discovered a 54 mm CL terrapin hibernating in moist sand eight meters from the high tide mark at a depth of about 0.3 m on 7 November 1967 in Virginia.

The same individual was periodically uncovered until 23 April the following year to determine depth of hibernation. Vertical and horizontal movements of 2-8 cm were observed.

Our preliminary observations and those of Pitler (1985) both suggest that young *M. terrapin* seek the underside of dense mats of vegetation. We suspect that small terrapins do this for several reasons. First, the tidal wrack and flotsam provide an abundant source of cover to terrapins at sizes when they are highly susceptible to predation by aquatic and terrestrial predators. Second, since the cover accumulates at the high tide line it is the nearest source of periodically flooded microhabitat to the nest site. Third, in addition to providing moist conditions, the summer temperatures under the debris are well below those of the surface outside the mat (pers. obs.). Fourth, numerous small invertebrates are found beneath the mats, providing a potential source of food for young terrapins. Allen and Littleford (1955) noted that newly hatched terrapins were rather indiscriminate in their initial food habits but preferred shellfish and snails (*Littorina irrorata*). Our observations have revealed high concentrations of small fiddler crabs (*Uca* spp.), square-backed crabs (*Sesarma* spp.), marsh periwinkles (*Littorina irrorata*) and miscellaneous small insects and amphipods under the *Spartina* mats, all potential food items for young terrapins.

Although it seems logical that hatchling and juvenile terrapins might spend their early years under mats of debris in the marsh, we have been unable to locate these smaller individuals despite intensive searches. It is possible that smaller size classes exist at very low numbers due to heavy predation. Although juvenile habitat preferences can only be identified by more thorough behavioral studies, these limited observations do provide evidence that hatchling *M. terrapin* are not averse to temporarily utilizing the microhabitat beneath tidal wrack.

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LITERATURE CITED

- Allen, J. F., and R. A. Littleford. 1955. Observations on the feeding habits and growth of immature diamondback terrapins. *Herpetologica* 11:77-80.
- Anderson, P. K. 1958. The photic responses and water-approach behavior of hatchling turtles. *Copeia* 1958:211-215.
- Burger, J. 1976. Behavior of hatchling diamondback terrapins (*Malaclemys terrapin*) in the field. *Copeia* 1976:742-748.
- _____. 1977. Determinants of hatching success in diamondback terrapin, *Malaclemys terrapin*. *Amer. Midl. Nat.* 97:444-464.
- _____, and W. A. Montevecchi. 1975. Nest site selection in the terrapin *Malaclemys terrapin*. *Copeia* 1975:113-119.
- Cagle, F. R. 1952. A Louisiana terrapin population (*Malaclemys*). *Copeia* 1952:74-76.
- Coker, R. E. 1906. The natural history and cultivation of the diamond-back terrapin, with notes on other forms of turtles. *North Carolina Geol. Surv. Bull.* 14:1-67.
- Hurd, L. E., G. W. Smedes, and T. A. Dean. 1979. An ecological study of a natural population of diamondback terrapins (*Malaclemys t. terrapin*) in a Delaware salt marsh. *Estuaries* 2:28-33.
- Lawler, A. R., and J. A. Musick. 1972. Sand beach hibernation by a northern diamondback terrapin, *Malaclemys terrapin terrapin* (Schoepff). *Copeia* 1972:389-390.
- Lovich, J. E., and J. W. Gibbons. 1990. Age at maturity influences adult sex ratio in the turtle *Malaclemys terrapin*. *Oikos* 59:126-134.
- Montevecchi, W. A., and J. Burger. 1975. Aspects of the reproductive biology of the northern diamondback terrapin *Malaclemys terrapin terrapin*. *Amer. Midl. Nat.* 94:166-178.
- Pitler, R. 1985. *Malaclemys terrapin terrapin* (northern diamondback terrapin). *Behavior. Herpetol. Rev.* 16:82.
- Seigel, R. A. 1980. Nesting habits of diamondback terrapins (*Malaclemys terrapin*) on the Atlantic coast of Florida. *Trans. Kansas Acad. Sci.* 83:239-246.
- _____. Parameters of two populations of diamondback terrapins (*Malaclemys terrapin*) on the Atlantic coast of Florida. In R. A. Seigel, L. E. Hunt, J. L. Knight, L. Malaret, and N. L. Zuschlag (eds.), *Vertebrate Ecology and Systematics—a Tribute to Henry S. Fitch*. *Mus. Nat. Hist., Univ. Kansas, Spec. Publ. No.* 10, pp.77-87.
- Teal, J. M. 1958. Distribution of fiddler crabs in Georgia salt marshes. *Ecology* 39:185-193.

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