# Hibernation of the Northern Diamondback Terrapin, *Malaclemys terrapin terrapin*

**ABSTRACT: Studies of adult northern diamondback terrapins (*Malaclemys terrapin terrapin*) in the salt marshes on the Atlantic Ocean side of Cape May Peninsula reveal that from mid-November through December, terrapins gradually migrate from the open waters of the sounds into the marsh creeks. Within the creeks, hibernating diamondbacks hibernate as isolated individuals or in small groups. Three hibernating methods are used: 1) resting on the bottom under water, 2) burial atop creek banks, and 3) taking refuge beneath undercut banks. Hibernating diamondbacks apparently remain dormant all winter.**

## Introduction

Heavily exploited in the early 1900's, diamondback terrapin populations have recovered (Hurd, et al. 1979), and these turtles are once again abundant and conspicuous components of New Jersey salt marshes. Although there has been a resurgence in the numbers of diamondbacks, relatively little is known about their habits, life cycle, or role in the marsh ecosystem. Early publications dealing with the biology of *Malaclemys terrapin* were based on captive specimens reared for experimental purposes at a United States government research station in Beaufort, North Carolina (e.g., Barney 1922; Coker 1906, 1920; Hay 1904; Hildebrand 1929, 1932, 1933). With the exception of several recent papers on nesting ecology of the northern diamondback terrapin (Burger and Montevecchi 1975; Montevecchi and Burger 1975; Burger 1976a, 1976b), little has subsequently been published on diamondback natural history. A survey of the standard works on North American turtles (Pope 1939; Carr 1952; Ernst and Barbour 1972) reveals little information on the hibernation of other aquatic emydines with the exception of brief remarks about two species of *Clemmys* (Ernst 1976, 1977), and a thorough study of the painted turtle, *Chrysemys picta,* in Pennsylvania (Ernst 1972).

This study provides information on the hibernation behavior of free-ranging adult populations of the northern diamondback terrapin in salt marshes of southern New Jersey.

## Materials and Methods

Specimens were collected during December, 1973 and January, 1974. Hibernating turtles were located in the field by probing the soft banks or creek bottoms with rods or poles. All hard objects encountered were excavated. Size and sex were recorded for 311 specimens. Qualitative information on the distribution and behavior of hibernating diamondbacks is based on three decades of observation by the senior author while collecting *Malaclemys terrapin terrapin* for market, and on observations by the junior authors during the winter of 1974–75. (By New Jersey law, diamondbacks may only be collected in winter).

Information on summer distributions comes from regular otter trawls in the channels conducted as part of the Wetlands Institute Fish Survey 1973–1977, and from traps set in the creeks and sounds in July and October, 1978. Data on temperature and salinity are monthly means of measurements from the study area from 1973 through 1975.

### Study Area

The area studied is situated along the Atlantic coast of Cape May County, New Jersey. This region consists of extensive areas of salt meadows (primarily *Spartina alterniflora*), narrow creeks, large open sounds, and a broad, relatively deep channel that forms part of the Intracoastal Waterway. The sounds are extremely shallow (0.1–0.5 m deep at mean low water). Most of the water circulation is provided by tidal flushing (an average of 1.16 m between high and low tides; maximum spring tidal range is 2.14 m in this area). Relatively few fresh water creeks flow into the marsh, and none of these is of great size. Salinity remains near 30‰ all year. Sediment throughout the entire area is silty clay.

## Results

In the late spring, summer, and early fall otter trawls and baited traps catch individuals in the creeks, sounds and main channels. Diamondbacks appear active then and are more or less uniformly spread throughout the marsh waters. By mid-to-late November, however, diamondbacks become sluggish as water temperatures drop from an average summer high of 22–24 °C to a range of 6–10 °C. In late fall, diamondbacks may be seen on the bottom in the very shallow water of creeks and sounds (<1 m) either lying or crawling slowly on the bottom. From mid-November until, generally, the end of December, terrapin population distribution undergoes a marked shift. During the most severe months of the winter, few, if any, diamondbacks are sighted in the sounds; the bulk of the population is now found concentrated in creeks 2–5 m wide.

Three hundred and eleven hibernating specimens measured during the winter of 1973–74 ranged in size from 9.7 to 18.6 cm in carapace length (Fig. 1). Owing to the marked sexual dimorphism characteristic of this species (adult females are much larger than males), the smaller specimens tended to be mostly males whereas the larger ones were all females. We have never encountered juvenile hibernating diamondbacks. It may be that our field techniques are inappropriate for recovering very small specimens, or perhaps juveniles hibernate separately from adults.

Terrapins may be found in several distinct types of hibernation sites. Individuals may rest on the bottom along the deeper reaches of creeks, often in natural depressions. In such places the water depth at low tide generally ranges from 1.5–2.5 m. Specimens collected from such areas will frequently be covered with a thin layer of mud. A second hibernating technique employed by many diamondbacks is to bury themselves 0.15 to 0.5 m deep in the sides of creek banks near the



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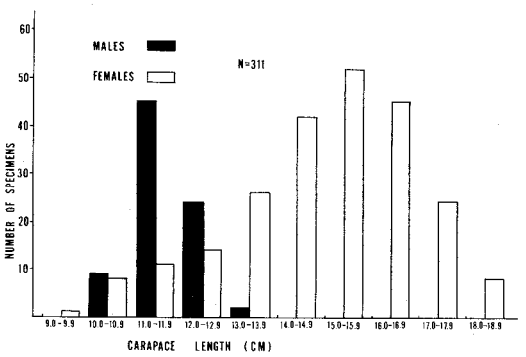


Fig. 1. Size distribution of a sample of hibernating diamondback terrapins taken from the study area in early December 1973 and late January 1974. Carapace length is measured in a straight line along the midline of the shell rather than over its anteroposterior curve.

upper tide limit. Favored sites for burial are places where banks have started slumping into the creeksthey border. Such areas are largely free of marsh vegetation, and there are relatively few roots to impede digging.

Group burials occur in yet another type of situation, beneath undercut banks in the intertidal zone. The natural cavities occupied by hibernating groups evidently result from current scouring and are necessarily limited to the outer bends of shallow creeks. A thin veneer (<1 cm) of mud always covers the group so that the turtles are not exposed during periods of low tide.

Mortality among hibernating adult diamondbacks seems to be very low. Specimens recovered from the three types of hibernating sites described in this paper invariably are alive, which strongly suggests that very few terrapins die during the winter while buried or under water. No more than half a dozen carcasses have ever been seen in the creeks in any given winter by the senior author from 1940–1978. Even during the record cold winter of 1976–77, no exceptional mortality was observed in the study area. Thus, winter mortality appears to be inconsequential for the population reported here. Diamondbacks in our study area usually become active again during April or May, but were never seen active on the marsh in winter, even on the warmest days. Gut analysis of 10 diamondbacks showed all to be empty.

## Discussion

Studies on captive *Malaclemys* in an impoundment in North Carolina (Barney 1922; Coker 1906, 1920; Hay 1904; Hildebrand 1929, 1932, 1933) indicate that hibernation commences there from mid-October to early November. The terrapins were reported to bury themselves in mud on the bottoms of creeks and emerge briefly during warm spells throughout the winter to feed. New Jersey diamondbacks, in contrast, may sometimes remain active through late December, but are not seen again on the marshes until the following spring. The fact that the captive turtles did not show variation in hibernation sites may be due to the limited range of options open to them. Their differing behavior may also be partly or even largely attributable to latitudinal differences.

Of the turtles investigated thus far, this is the first suggestion of uninterrupted dormancy throughout the winter. *Chrysemys* (Ernst 1972), *Chelonia* (Felger, et al. 1976), probably *Clemmys* and even captive diamondbacks from North Carolina are intermittently active during the winter. The mud of salt marshes is rich in organic material and virtually devoid of oxygen (Ranwell 1972). To survive buried for prolonged periods in this environment suggests that *Malaclemys terrapin terrapin* rely on a lowered metabolic rate, possibly combined with an unusually efficient anaerobic metabolism during hibernation. Such biochemical adaptations are utilized by *Chelonia mydas, Chrysemys scripta,* and *Sternotherus minor* while diving for extended periods (Belkin 1962, 1968; Jackson 1968; Hochacka, et al. 1973; Hochacka and Somero 1973).

Diamondbacks have a much broader latitudinal range than most turtles. In view of the fact that this investigation is restricted only to the northernmost of seven known subspecies of *Malaclemys,* it would be of considerable interest to undertake comparable studies on hibernation activities in more southerly populations. We would not be surprised to discover additional modes of hibernation elsewhere within the distribution of the species. It is even conceivable that the southernmost subspecies, the subtropical mangrove terrapin (*M. t. rhizophorarum*), may not hibernate at all.

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