Diamondback Terrapin
Malaclemys terrapin

Contributors (2005): Erin Levesque (SCDNR), J. Whitfield Gibbons (SREL), DuBose Griffin (SCDNR), David Owens (College of Charleston)
Reviewed and Edited (2012): Erin Levesque (SCDNR)

DESCRIPTION

Taxonomy and Basic Description

The diamondback terrapin is a small, long-lived estuarine turtle endemic to coastal marshes, estuarine bays, lagoons and creeks ranging from Cape Cod, Massachusetts to the Gulf Coast of Texas. Currently, there are 5 (Hartsell 2001) or 7 (Ernst et al. 1994) subspecies. More recently, Hart (2004) identified six management units. The subspecies found in South Carolina is *Malaclemys terrapin centrata*.

Terrapins have varied coloration from black to spotted patterns on the soft tissue and dark or light-colored scutes with strong concentric layers on the carapace. The hind margin of the carapace curls up instead of flaring. Hind legs are large and toes have extensive webs. These turtles are strong, fast swimmers that feed on a variety of mollusks, crustaceans and other invertebrates. In South Carolina, salt marsh periwinkles (*Littoraria irrorata*) and blue crabs (*Callinectes sapidus*) are among the terrapin's primary food sources (Tucker et al. 1995; Levesque 2000).

Terrapins are sexually dimorphic. Females are much larger than males and reach 15 to 18 cm (6 to7 in.) in length; males reach 10 to 13 cm (4 to 5 in.) in length. Adult females also have enlarged heads. Terrapins hibernate in the mud during winter and mate in the spring. Eggs are laid May through early August and clutches have 5 to 12 eggs (Pritchard 1979). The number of clutches laid per female in South Carolina is undocumented; however two clutches may be common (D. Owens, College of Charleston, pers. obs.).

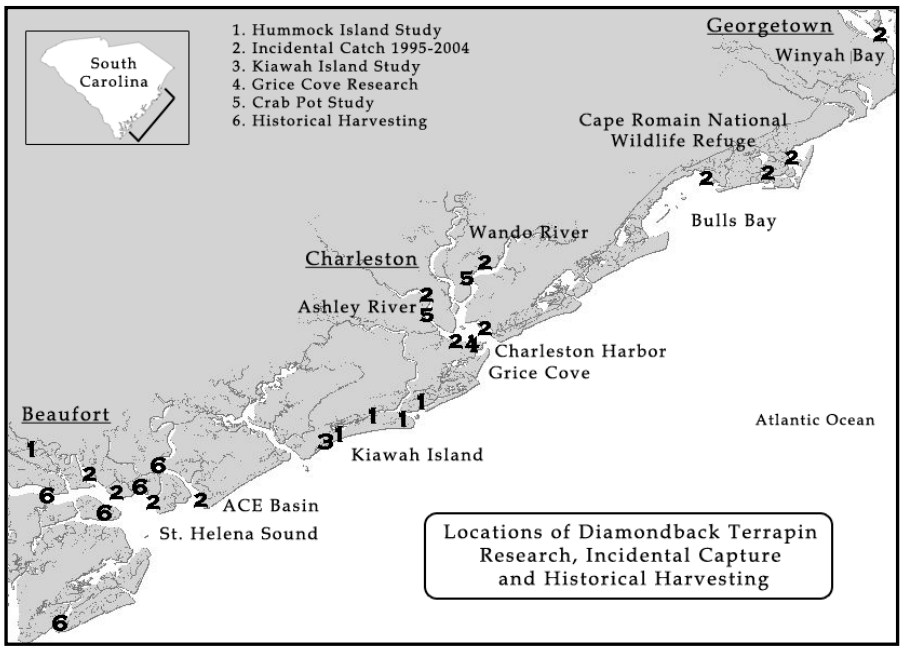
Status

The International Union for Conservation of Nature and Natural Resources (IUCN) lists terrapins as a species of lower risk/near threatened (Tortoise & Freshwater Turtle Specialist Group 1996). Prior to 2000 in South Carolina, the law allowed a harvest season, but this had not been active since the 1970s (R. Gault, terrapin harvester, pers. comm.). In 2000 the law was altered to allow commercial harvest by permit, however no permits were issued. In 2006, Chapter 5 Section 50-

5-2300 of South Carolina law was amended to read, “It is unlawful to take or possess diamond-backed terrapin for a commercial purpose. A person may possess no more than two diamond-backed terrapin for a noncommercial purpose. Nothing in this section prohibits the incidental catch of terrapin by persons engaged in a lawful fishery when the terrapin are returned immediately to the water.” The status of the species is listed as unknown in South Carolina (S?) and apparently secure globally (G4) (NatureServe 2011).

POPULATION SIZE AND DISTRIBUTION

The current status of most populations of terrapins is unknown or declining (Seigel and Gibbons 1995). The species experienced near extinction in the early 1920s because of commercial over-harvest. Commercial harvest declined in the late 1920s, and terrapin populations increased (Gibbons et al. 2001). Mr. Robert Gault, the last terrapin harvester in the state, reported catches of nearly 500 turtles in two to three days of net fishing in the Beaufort area in the 1970s.



Two decades of monitoring terrapins in four creeks adjacent to the Kiawah River has documented a decline since the early 1990s and local extirpation (Gibbons et al. 2001; Tucker et al. 2001). Along the South Carolina coast, incidental catch data from 1995 through 2004 of diamondback terrapins in research trammel nets remained consistent. However, data from 1995-2009 indicated that while the Ashley River and Charleston Harbor populations were stable, the Wando River showed a decrease in incidental catches (Broyles 2010). The possible explanation for decreased catches was a steep increase in change of land use on the Wando River, while areas surrounding the Ashley River and Charleston Harbor experienced little land use change (Broyles 2010). Incidental captures north and south of the Charleston Harbor estuary are much less common (Levesque 2000).

Genetic studies in North and South Carolina indicate that terrapin populations from these states are not significantly different (Hart 2004; Hauswaldt 2004) and should be treated as one management unit. A previous genetic study using a different genetic marker was unable to detect a difference between the Carolinas and Georgia (Lamb and Avise 1992). The Diamondback Terrapin Working Group (DTWG) was formed in September 2004. Georgia and both Carolinas comprise the southeastern section of this working group.

It should be noted that in 1947, several thousand diamondback terrapins were released into Cape Romain National Wildlife Refuge (CRNWR) waters from the North Carolina Beaufort Fishery Station (Anonymous 1947). The genetic stock of these terrapins is not known. This should be taken into consideration when determining the genetic stock of diamondback terrapins in South Carolina waters.

HABITAT AND NATURAL COMMUNITY REQUIREMENTS

Terrapins are endemic to estuarine habitats. They are the only emydid turtle that can survive in a high salinity environment without accessing a freshwater source. Terrapins nest on land and require access to dry, soft sand/soil to deposit their eggs. There is also evidence of high site fidelity and low recruitment and/or dispersal among tidal creeks. If a population were extirpated from a tidal creek, recruitment from other creeks would be very slow to repopulate the area (Gibbons et al. 2001).

CHALLENGES

Major problems for diamondback terrapins are many; one is the loss or degradation of nesting habitat resulting from coastal development. Also, nests are destroyed by native (raccoons and mink) and non-native predators (fire ants) as well as erosion and storm events. Vehicle inflicted mortality of females during the nesting season is common where a highway separates nesting sites from tidal creeks. Mortality is also associated with the mowing of causeway shoulders (T. Murphy, SCDNR, pers. comm.). In the water, terrapins may be increasingly vulnerable to injury or mortality due to encounters with watercraft (Cecala et al. 2009).

A major source of mortality in the marine environment is the presence of recreational, commercial and abandoned/ghost crab pots. In the Ashley and Wando Rivers, Bishop (1983) estimated that the mean daily terrapin catch per baited crab pot was 0.16 in April and May with 10 % mortality. A statewide survey in the fall of 2003 documented nearly 10,000 commercial hard crab pots (M. Maddox, SCDNR, pers. comm.). Grosse et al. (2011) found terrapin density in Georgia tidal creeks to be negatively correlated with crabbing intensity. In a Kiawah Island study, mean terrapin size increased in the presence of crabbing; these results were attributed to the greater survival of larger terrapins (females) too big to gain entry into pots (Dorcas et al. 2007). Other problems include commercial harvesting (if permitted), destruction of food resources, environmental degradation and contamination (through increased sedimentation, nutrient enrichment, oil spills and filling/draining marshes), boat and propeller mortality, and the commercial pet trade (D. Owens, College of Charleston, pers. obs.).

Climate change is a potential threat to sea turtles as it may affect these species in three ways: (1) loss of dry sand beaches to sea level rise; (2) lethal high temperatures within the nest that would cause egg/hatchling mortality or decrease hatchling fitness; or (3) a female biased sex ratio of hatchlings due to increased nest temperatures. Terrapins, like some other reptiles, have temperature-dependent sex determination (TDSD) with higher temperatures favoring the development of female terrapin offspring and lower temperatures favoring males (Roosenburg 1996; Jeyasuria and Place 1997; Jeyasuria et al. 1994).

CONSERVATION ACCOMPLISHMENTS

A Diamondback Terrapin Working Group (DTWG) for the species' entire range has been organized to facilitate information exchange and to set research and management priorities; this group was formed September 2004. In 2000, the South Carolina legislature recognized the value of science-based management of marine resources and changed commercial access to the South Carolina terrapin resource from a seasonally open fishery to one managed with discretion by the Department of Natural Resources (D. Theiling, SCDNR, pers comm.). Then, in 2006, Chapter 5 Section 50-5-2300 of South Carolina law was amended to read, "It is unlawful to take or possess diamond-backed terrapin for a commercial purpose. A person may possess no more than two diamond-backed terrapin for a noncommercial purpose. Nothing in this section prohibits the incidental catch of terrapin by persons engaged in a lawful fishery when the terrapin are returned immediately to the water."

There have been local research findings and accomplishments throughout South Carolina. Sonic telemetry has been useful in studying site fidelity of terrapins. Genetic studies indicate that high site fidelity is not reflected in population genetic structure; no significant genetic differentiation exists among estuaries in North and South Carolina. Further, terrapins between South Carolina and New York are more similar to those from Texas than to terrapins in Florida, possibly because of intentional mixing (Hauswaldt 2004). Multiple paternity has been reported to occur in diamondback terrapins (Hauswaldt 2004). Genetic management units are not estuary specific; therefore, terrapins within the units defined by Hart (2004) can be translocated to areas where terrapins are extirpated (Hauswaldt 2004).

Diamondback terrapin nesting was apparent on 5 of 16 hummock islands inventoried during a 2003 through 2004 South Carolina Department of Health and Environmental Control (SCDHEC)/SCDNR preliminary study in South Carolina (W. McCord, SCDNR, pers. comm.). Seasonal reproductive activity of Charleston Harbor estuary terrapin populations has been determined and may be used to reduce anthropogenic threats (Lee 2003). Grice Cove Beach in the Charleston Harbor estuary was identified as an important nesting beach for diamondback terrapins compared with other beaches in this system. Highest nesting activity was early May to mid June (Riollana 2003).

A terrapin population study in four tidal creeks adjacent to the Kiawah River has been ongoing since 1983; to date, there have been 1,632 individual terrapins captured and 1,831 recaptures (M. Dorcas, Davidson College, pers. comm. 2012). The Town of Kiawah has sighting forms posted on the town's website so residents and visitors can report incidental encounters with terrapins as a supplement to this long-term study.

Currently, the Town of Kiawah Environmental Committee is sponsoring a community effort to outfit crab pots with bycatch reduction devices (BRDs) free of charge (http://www.kiawahisland.org/Wildlife/DiamondbackTerrapin.aspx). Recreational crab pots have been shown to adversely affect diamondback terrapin populations in the Kiawah River (Hoyle and Gibbons 2000). [Note: See ongoing research by Peter King (Francis Marion University) on terrapins and his involvement in educating commercial crab fishermen about the removal of

phantom traps.] Crab pots with BRDs showed an increase in the number of legal crabs caught in a Louisiana study (Guillory and Prejean 1998), and a significant decrease in terrapin capture without a change in number or size of blue crabs caught was shown in Florida (Butler et al. 2007) and Chesapeake Bay (Rook et al. 2010). Hart et al. (2011) showed that in addition to BRDs, crab pot proximity to shore restrictions and seasonal regulations might reduce terrapin catch by up to 95% without altering crab catch rates. The Town of Kiawah Island also sponsored a "Save the Diamondback Terrapin" program. Numerous educational materials have also been printed and distributed (M. Blizard and E. King, pers. comm.).

CONSERVATION RECOMMENDATIONS

- Develop and implement long-term coastwide standardized surveys to estimate the abundance and distribution of South Carolina's terrapin population.
- Quantify anthropogenic sources of terrapin mortality, with focus on life stage and sex-specific mortality rates.
- Determine effectiveness of bycatch reduction devices on crab pots to exclude terrapins.
- Identify sites of significant or potential terrapin mortality from vehicles and mowers.
- Determine habitat of 1 and 2-year-old juvenile terrapins.
- Establish several intensive studies to determine population parameters required for evaluating the status of diamondback terrapins, such as mortality rates and nesting effort/success.
- Identify and protect critical diamondback terrapin nesting habitats throughout the state, especially from beach disturbances by visitors, boaters and dogs during the nesting season.
- Develop predator control programs for critical diamondback terrapin nesting beaches.
- Create a hatchery for terrapins for reintroductions to creeks where they were previously eliminated.
- Identify and protect critical diamondback terrapin mating aggregations throughout the state.
- Examine the potential benefits of requiring effective BRDs in recreational and commercial crab pots for reduction of diamondback terrapin mortality.
- Examine the potential benefits of requiring effective degradable panels or panel attachments in recreational and commercial crab pots to reduce diamondback terrapin mortality associated with abandoned crab pots.
- Develop an abandoned/ghost crab pot collection program with partners throughout the state to reduce terrapin mortality in these traps. Evaluate the need for changing the status of the terrapin to a species "in need of management" under the South Carolina Nongame and Endangered Species Conservation Act.
- Collaborate with the South Carolina Department of Transportation (SCDOT) to negotiate restrictions of causeway mowing during the terrapin nesting season.
- Encourage the salvage of eggs from road-killed female terrapins for an incubation and release program by local animal care groups.
- Educate the public about how they can help conserve the diamondback terrapin and specifically emphasize responsible actions when using crab pots. Produce education materials to be distributed coastwide.

- Erect crossing signs along roadways alerting motorists about crossing diamondback terrapins during the breeding season. Signs should be theft proof or removed each year at the end of the breeding season.
- Develop a South Carolina Department of Natural Resources web page on diamondback terrapins. A web site will enhance collaboration for the southeastern portion of the DTWG.
- Participate in and contribute to the DTWG by attending triennial meetings.
- Collaborate with institutions, partners and nongovernmental organizations on future research and management actions to protect the diamondback terrapin.

MEASURES OF SUCCESS

As results from current research and surveys are identified and analyzed, we will initiate projects to address specific needs that arise from these results, with the ultimate measure of success being to stabilize or increase populations of diamondback terrapins.

LITERATURE CITED

Anonymous. 1947. Annual Report on the Cape Romain National Wildlife Refuge to the Regional Office of USFWS.

Barney, R.L. 1922. Further notes on the natural history and artificial propagation of the diamond-back terrapin. Bulletin of U.S. Bureau of Fisheries. 38:91-111.

Bishop, J.M. 1983. Incidental capture of diamondback terrapins by crab pots. Estuaries 6:426–430.

Broyles, E. 2010. Diamondback terrapins (Malaclemys terrapin) of South Carolina: Population estimate, sex ratios, and distribution. M.S. Thesis. The Graduate School at the College of Charleston. Charleston, South Carolina. 63 pp.

Butler, J.A., and G.L. Heinrich. 2007. The Effectiveness of Bycatch Reduction Devices on Crab Pots at Reducing Capture and Mortality of Diamondback Terrapins (*Malaclemys terrapin*) in Florida. Estuaries and Coasts 30(1): 179-85.

Cecala, K. K., J. W. Gibbons and M. E. Dorcas. 2009. Ecological effects of major injuries in diamondback terrapins: implications for conservation and management. Aquatic Conservation: Marine and Freshwater Ecosystems 19(4): 421-427.

Dorcas, M. E., J. D. Willson, and J. W. Gibbons. 2007. Crab Trapping Causes Population Decline and Demographic Changes in Diamondback Terrapins Over Two Decades. Biological Conservation 137(3): 334-40.

Ernst, C.H., J.E. Lovich, and R.W. Barbour. 1994. Turtles of the United States and Canada. Smithsonian Institution Press. Washington and London. 578 pp.

Gibbons, J.W., J.E. Lovich, A.D. Tucker, N.N. Fitzsimmons and J.L. Greene. 2001. Demographic and ecological factors affecting conservation and management of the diamondback terrapin (*Malaclemys terrapin*) in South Carolina. Chelonian Conservation and Biology. 4(1): 66–74.

Grosse, A. M., J. C. Maerz, J. Hepinstall-Cymerman, and M.E. Dorcas. 2011. Effects of Roads and Crabbing Pressures on Diamondback Terrapin Populations in Coastal Georgia. Journal of Wildlife Management 75(4): 762-70.

Guillory, V. and P. Prejean. 1998. Effect of a terrapin excluder device on blue crab, *Callinectes sapidus*, trap catches. Marine Fisheries Review. 60(1):38-40.

Hart, K.M., and L.B. Crowder. 2011. Mitigating by-Catch of Diamondback Terrapins in Crab Pots. Journal of Wildlife Management 75(2): 264-72.

Hart, K.M. 2004. Integrating ecological and genetic data to develop an ecologically and evolutionarily sound management strategy for a continuously-distributed species, *Malaclemys terrapin*. Ph.D. Dissertation. Duke University. Durham, North Carolina. 235 pp.

Hartsell, T.D. 2001 Intraspecific variation in the diamondback terrapin, *Malaclemys terrapin*, and its ecological parameters. Ph.D. Dissertation. George Mason University. Fairfax, Virginia. 152 pp.

Hauswaldt, J.S. 2004. Population genetics and mating pattern of the diamondback terrapin (*Malaclemys terrapin*) Ph.D. Dissertation. University of South Carolina. Columbia, South Carolina. 216 pp.

Hay, W.P. 1917. Artificial propagation of the diamondback terrapin. U.S. Bureau of Fisheries, Economic Circular 5.

Hildebrand, S.F. 1929. Review of experiments on artificial culture of diamond-back terrapin. Bulletin of U.S. Bureau of Fisheries. 45:25-70.

Hoyle, M.E. and J.W. Gibbons. 2000. Use of a marked population of diamondback terrapins (*Malaclemys terrapin*) to determine impacts of recreational crab pots. Chelonian Conservation and Biology. 3(4): 735-737.

Jeyasuria, P., and A. R. Place. 1997. Temperature-Dependent Aromatase Expression in Developing Diamondback Terrapin (Malaclemys Terrapin) Embryos. Journal of Steroid Biochemistry & Molecular Biology 61(3-6): 415-25.

Jeyasuria, P., W. M. Roosenburg, and A. R. Place. 1994. Role of P-450 Aromatase in Sex Determination of the Diamondback Terrapin, Malaclemys Terrapin. Journal of Experimental Zoology 270(1): 95-111.

Lamb, T. and J.C. Avise. 1992. Molecular and population genetic aspects of mitochondrial DNA variability in the diamondback terrapin, *Malaclemys terrapin*. Journal of Heredity. 83:262-269.

Lee, A.M. 2003. Reproductive biology and seasonal testosterone patterns of the diamondback terrapin, *Malaclemys terrapin*, in the estuaries of Charleston, South Carolina. M.S. Thesis. The Graduate School at the College of Charleston (former University of Charleston). Charleston, South Carolina. 100 pp.

Levesque, E.M. 2000. Distribution and ecology of the diamondback terrapin (*Malaclemys terrapin*) in South Carolina salt marshes. M.S. Thesis. The Graduate School at the College of Charleston (former University of Charleston). Charleston, South Carolina. 68 pp.

NatureServe. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: March 27, 2012).

Pritchard, P.C.H. 1979. Encyclopedia of Turtles. T.F.H. Publications. Neptune, NJ. 895 pp.

Riollano, A.I. 2003. Nesting behavior of diamondback terrapins (*Malaclemys terrapin*) in Grice Cove, South Carolina. Unpublished Report to the South Carolina Department of Natural Resources.

Rook, M.A., R.N. Lipcius, B.M. Bronner, R.M. Chambers. 2010. Bycatch reduction device conserves diamondback terrapin without affecting catch of blue crab. Marine Ecology Progress Series 409: 171-179.

Roosenburg, WM. 1996. Maternal condition and nest site choice: An alternative for the maintenance of environmental sex determination?American Zoologist 36(2): 157-168.

Seigel, R.A. and J.W. Gibbons. 1995. Workshop on the ecology, status, and management of the Diamondback terrapin (*Malaclemys terrapin*), Savannah River Ecology Laboratory, 2 August 1994: Final Results and Recommendations. Chelonian Conservation and Biology. 1(3):240-243.

Tortoise & Freshwater Turtle Specialist Group 1996. Malaclemys terrapin. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 29 March 2012.

Tucker, A.D., N.N. Fitzsimmons and J.W. Gibbons. 1995. Resource partitioning by the estuarine turtle *Malaclemys terrapin*: trophic, spatial and temporal foraging constraints. Herpetologica. 51(2):167-181.

Tucker, A.D., J.W. Gibbons and J.L. Greene. 2001. Estimates of adult survival and migration for diamondback terrapins: conservation insight from local extirpation within a metapopulation. Canadian Journal of Zoology. 79:2199-2209.

Zimmerman, T.D. 1989. Latitudinal reproduction variation of the salt marsh turtle, the diamondback terrapin (*Malaclemys terrapin*). M.S. Thesis. The Graduate School at the College of Charleston (former University of Charleston). Charleston, South Carolina. 54 pp.