# Assessing Effects of Land Development on Diamondback Terrapin Productivity

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## Abstract

Diamondback terrapins, (*Malaclemys terrapin*) have been shown to exhibit strong nest site philopatry, making the survival of nesting females, nests, and hatchlings particularly vulnerable to habitat change. Terrapin productivity is thought to be particularly sensitive to alterations or loss of the immediate nesting beach and of the proximate nursery wetlands to various forms of shoreline development. In 2002 and 2003 the USGS surveyed beaches in the Maryland portion of Chesapeake Bay for evidence and distribution of terrapin nesting. The survey covered 3,000 km of shoreline and recorded GPS locations of over 7,760 nesting attempts. From data collected at these locations, we identified local factors associated with land development that might place future terrapin nesting productivity at risk. Using Arc GIS and county-based land coverage maps for years 2004 through 2008, we measured distance between each nest collected during the 2002 survey to attributes related to both natural and human-impacted habitats such as roadways, shorelines, wetlands, and refuge sites. A series of logistic regressions applied for each map "year" was used to identify areas of potential concern, that is, sites combining both „historically" elevated concentrations of nesting attempts and areas within the range of land and residential development. This application of GIS can be used to identify areas in urgent need of preservation for terrapins from rapidly expanding human development.

## Introduction

The small Diamondback terrapin (Malaclemys terrapin) is unique among turtles in that it "makes its home in the distinctly tidal regions where salt and brackish waters ebb and flow" (Coker, 1920) such as in the Chesapeake Bay. Once abundant throughout its geographic range, the terrapin is increasingly a species of concern as its native estuarine habitat is being lost and fragmented by shoreline development. Findings from a long term demography study along the western shore's Patuxent River reported up to a 75% decline in the population within the last decade. As part of a series of research studies to evaluate the terrapin's status throughout the Chesapeake Bay, the USGS/PWRC analyzed findings from survey of presence/absence of nesting activity on beaches along the Chesapeake Bay conducted in 2002/03 in terms of habitat (substrate and vegetation cover) and proximity to development (roads, illumination). These data are now being incorporated into a GIS to evaluate regional environmental features such as water quality (SAV distribution, point source pollutants, nitrogen and phosphates), urban development (proximity to roads, illumination), and climatic factors (temperatures and precipitation). Terrapins are considered to exhibit strong nest philopatry. Analyses of the GIS generated for the 2002/2003 will be applied to project how the distribution of their nesting activity may be affected by increased shoreline development.

## Methods

The area surveyed extends from north of Rock Hall/ Eastern Neck NWR to the MD-VA border on the eastern shore, and from south of Baltimore to Point Look out on the western shore. Sites were located along the shoreline of the Bay, including its rivers and islands.
On line transects parallel to the high tide line were followed, allowing a 10-20 m border if area permitted. Handheld GPS units recorded the lat/long coordinated for the transect and locations of any observed sign of nesting. The signs included:

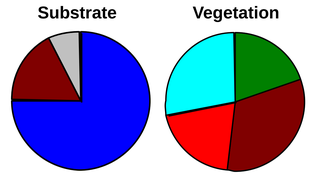
- Presence of turtles on land
- Newly formed nest mounds, fresh tracks leading up and down the beach, recently deposited eggs.
- Hatchlings or their tracks.
- Partially or wholly predated turtles or remaining shells.
- Predated nest sites. If clusters of more than 1 nest were located at a GPS reading, these were counted as separate events.

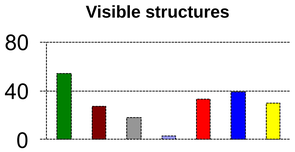
A checklist was completed at each site identifying the dominant ground substrate/s, and vegetation cover, the presence of wetlands and/or other attributes and structures visible from the nest site.

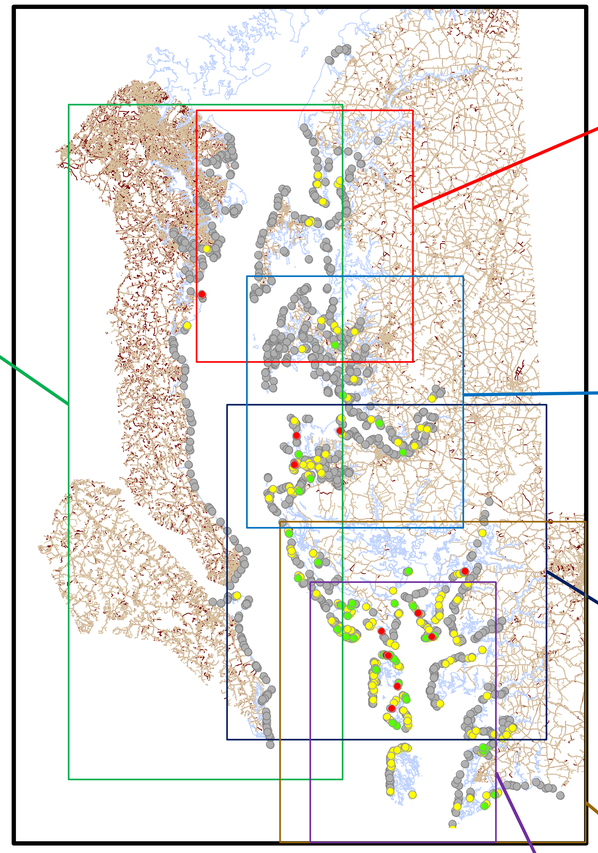
The information from the survey was transcribed into GIS maps (Arc GIS v 8.2-9.0). Cover layers of habitat, commercial and residential development, and environmental factors from 2002/2003 are being imported to evaluate features potentially related to nest site selection. Layers of these features as measured in 2007/2008 will be used to project effects on nest distribution. A listing of URL document/data are available upon request.

## Results

Western Shore



Maryland Chesapeake Bay –Survey for presence of nesting activity

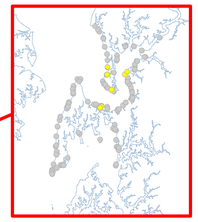
Each site was visited 1 time between May – August 2002.

Shoreline outline is in blue.

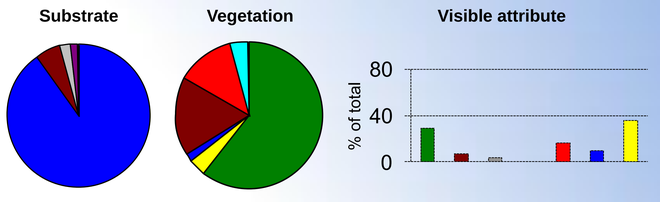
Density of predated nests along transects (nests/m):

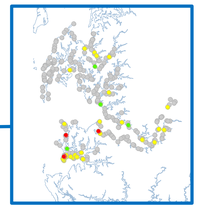
- 0-0.09
- 0.093-0.31
- 0.32-0.76
- 0.761-1.97

Maps for 2003 (pale yellow) and 2008 (brown) roads were used to generate mean distance from each active nest to the nearest road.

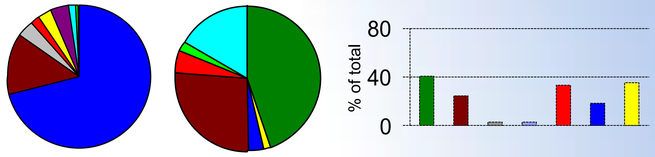


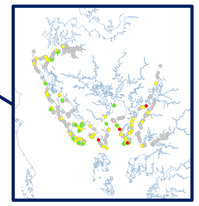
Upper Eastern Shore



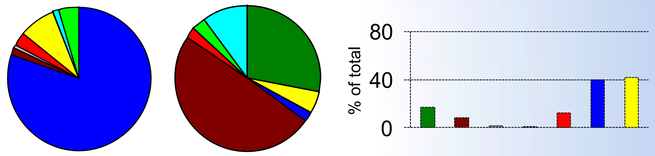



Eastern Bay to Choptank

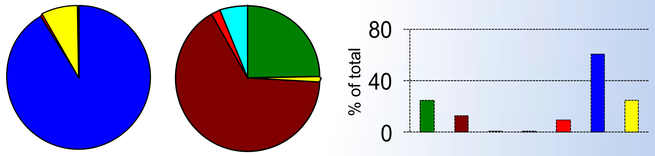


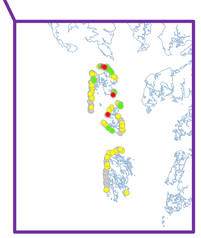



Dorchester County

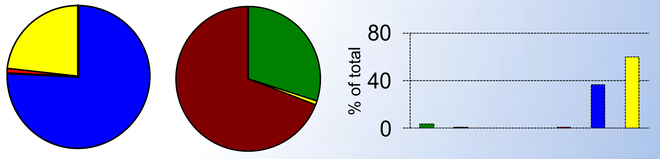


Tangier Sound



Tangier Sound Islands




### KEY

**Substrate**
- Sand
- Sand+Gravel
- Sand+Rock
- Sand+Silt
- Sand+Clay
- Sand+Gravel+Rock
- Sand+Gravel+Clay
- Sand+Silt+Clay

**Vegetation**
- Grass
- Shrub
- Trees
- Grass+Shrub
- Grass+Trees
- Shrub+Trees
- Grass+Shrub+Trees

**Visible structures**
- House
- Dock
- Road
- Park
- Hardened shoreline
- Saltmarsh
- None of the above

| | Upper Eastern Shore | Eastern Bay-Choptank | Dorchester County | Tangier Sound | Lower Bay Islands | Western Shore |
|---|---|---|---|---|---|---|
| **No. Stops** | 130 | 338 | 331 | 153 | 146 | 195 |
| **Total length (km)** | 28 | 44 | 43 | 37 | 21 | 55 |
| **Transect length (m) Mean ± SE** | 240±45 | 129±10 | 129±10 | 242±36.1 | 142±19 | 282±27 |
| **% stops with observed activities** | 48 | 43 | 68 | 76 | 90 | 17 |
| **Total no. observations** | 291 | 853 | 2911 | 1795 | 1868 | 194 |
| | | | **Percent of Total Observed Activity** | | | |
| **Predated nests** | 83 | 98 | 96 | 99 | 99 | 96 |
| **Live turtles** | 1.7 | 1.2 | 0.3 | 0 | 0.7 | 0 |
| **<48 hour nests** | 1.4 | 0.2 | 0.1 | 0 | 0.1 | 0 |
| **Presence of turtle tracks only** | yes | no | no | no | yes | no |
| **Presence of hatchlings/tracks** | no | no | no | no | yes | yes |
| **No. dead turtles on shore** | 3 | 3 | 16 | 14 | 5 | 4 |
| **Predated nests/m transect Mean ± SD** | 0.02 | 0.05 | 0.1 | 0.07 | 0.17 | 0.01 |
| **$R^2$ for Beach L x Predated nest** | 0.003 | 0.03 | 0.3 | 0.7 | 0.06 | 0.2 |
| | | | **Distance to closest road, 2003 (from ArcGIS)** | | | |
| **N** | 130 | 338 | 331 | 153 | N/A | 195 |
| **Mean ± SD** | 300±254 | 238±192 | 592±816 | 1012±851 | | 153±155 |
| **min (m)** | 2.8 | 2.9 | 3.5 | >15 | | 2.2 |

## Conclusions

Data on the habitat of the nesting sites presented in this poster are based on a single ground observation for each site. From this one year, we obtained information on the distribution of nesting locations, and a measure of relative density of nesting, as measured by predated nests/m transect, at each location. From this initial survey, the changes in the vegetation mix and proximity of structures reflect trends of on shore areas used by the diamondback terrapins. The Tangier Sound shoreline and uninhabited marsh islands support higher densities of nests as measured by predated nests/m. These same regions show far fewer visible commercially and residentially related structures, increased distance from roads, and significantly larger dandy areas open to nesting. Although we did not measure predation rates, observations point to raccoon predators dominating the more urban areas and fox, otter, rats, and raccoons accounting for predation on island and more remote locations. Whether we estimate total nesting based on a constant rate (80-90%) throughout the Bay or based on variable rates depending on proximity to urban areas, based on the densities measured, nesting success would be higher in the lower regions of the Bay as well.

As the Bay is being developed and managed for the future, commercial and residential encroachment into these critical areas could further reduce available nesting locations to levels observed in the upper Bay and severely impact the current overall terrapin populations.

We are applying the GIS tools to expand our 2002 findings to evaluate regional effects on habitat and project areas available for nesting in the future. Our initial analyses comparing road distribution from different years were unsuccessful; roads are not uniformly defined and comparable over time. However, we are currently importing and analyzing alternative features to address shoreline development from 2000 to the present. Despite our temporary set back, GIS remains a powerful tool for defining regional land use trends. By incorporating surveys such as this one, GIS will be valuable for developing the models needed to assist in making decisions for protecting habitats critical to wildlife, such as terrapin nesting beaches.

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