GIS ASSESSMENT OF TERRAPIN TURTLES NESTING AREAS IN NEED OF PROTECTION IN THE CHESAPEAKE BAY, MARYLAND.

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ABSTRACT: The present project evaluated, with the aid of GIS, current terrapin use of land on the Eastern shore of the Chesapeake Bay, as well as possible risks turtles might face if further urban development continues. GIS layers on development pressure and protected areas, land-use coverage maps, and USGS 2002 and 2003 terrapin nesting data, were employed in the analysis. The results show that the shoreline area of Dorchester County has significant nesting activity occurring in unprotected areas that are under an intense pressure from urban and agricultural development. Further research is suggested to better understand the dynamics of the nesting activity in that area. The establishment of new protected sites, based on the maps generated in the present study, is highly recommended.

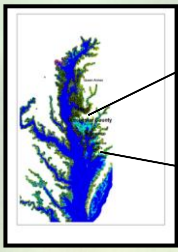
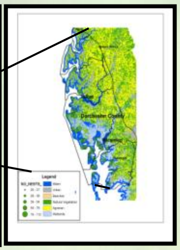
INTRODUCTION: The Diamondback terrapin is an estuarine emydid turtle that occurs along the Atlantic and Gulf coasts of North America, from Cape Cod, Massachusetts, to Corpus Christi Bay, Texas. The Chesapeake Bay, the largest marine estuary in the United States, is a highly complex ecosystem that represents a very important nesting and nursing site for many different terrestrial, marine, and freshwater species. One of these is the Northern diamondback terrapin (*Malaclemys terrapin terrapin*) a species that resides in the Bay throughout its life cycle. However, certain areas of the Chesapeake Bay have been subjected to intense development pressures, thus reducing the turtle nesting habitat availability.

Currently, the USGS Patuxent Wildlife Research Center is engaged in an extensive research initiative aimed at assessing the status of the diamondback terrapin in the Chesapeake Bay. As part of that initiative, the present project evaluated, with the aid of GIS, current terrapin use of land in the eastern shore area of the Bay, as well as possible risks turtles might face if further urban development continues.

MATERIALS: Software: ARCGIS 9 (ESRI) – Information Layers:1990 and 2000 classified Land-use raster coverages (provided by RESAC, Department of Geography, University of Maryland); Raster grid of Urban Development Pressure (Claggett, P.R. and C. Bisland, "Assessing the Vulnerability of Farms and Forest Lands to Development", manuscript under preparation, Chesapeake Bay Program Office, Annapolis, MD); 2002 and 2003 nesting sites point coverage (provided by Paula F.P. Henry, USGS Patuxent Wildlife Research Center); Polygon coverage of currently protected zones (provided by Peter R. Claggett, USGS- Land Data Manager. Chesapeake Bay Program Office).

Terrapin data were collected based on presence/absence of observed signs of nesting activity, primarily from predated nests located at sites throughout the Eastern shore, from Rock Hall to Crisfield, MD.

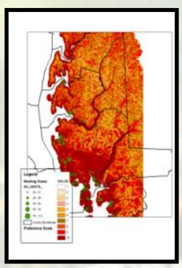
METHODOLOGY FLOW CHART

Step I: Create Subsets of All Layers

Each information layer is focused on the Eastern Shore.

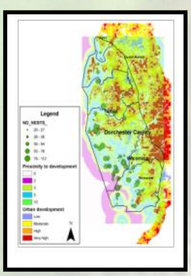
Habitat and land use categories are defined.



Step II: Find Current Nesting Habitat Preferences Relative to Land Use.

Layers employed: 2002 and 2003 nesting sites point coverage and 2000 classified Land-use raster coverage.

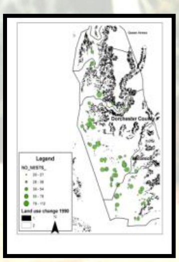
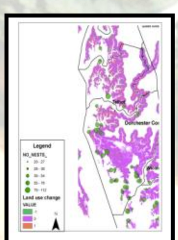
Customize ARC GIS to relate nest points to categories. Nesting site preference is assessed from total nests within each land-use category. Preference is rated on a scale from 1 (0 use) to 10 (high use).



Step III: Determine Proximity of Terrapin Nesting Sites to Urban Development

Layers employed: Raster grid of Urban Development Pressure and 2002/2003 nesting sites point coverage

Derive a distance grid from "epicenter" of urban development. Rings are assigned codes 1 (furthest) to 10 (nearest) according to proximity of nesting areas to each epicenter.

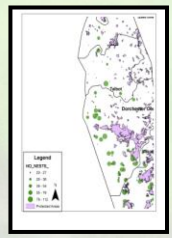
Step IV: Derive Estimate for Land Use Change .

Layers employed: 1990 and 2000 classified Land-use raster coverages

Categories are reclassified as natural /undisturbed (value = 2) and human impacted habitat (value = 1).

Direction of change is calculated by:
land use map 2000 – land use map 1990.

Map layers:
0 = no change
-1 = change from undisturbed to disturbed habitat,
+1= change from disturbed to undisturbed habitats

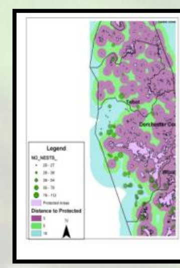


Step V: Delineate Unprotected Nesting Areas

Layers employed: 2002/2003 nesting sites point coverage and Polygon coverage of currently protected zones

Identify nests that lie within and outside polygons, and create a 200m buffer around nests.

Convert data set to raster and reclassify map into unprotected nest areas (value = 1) and
all other areas (value = 0).



Step VI: Obtain Proximity of Terrapin Nesting Sites to Resource Managed/Protected Areas.

Layers employed: 2002/ 2003 nesting sites point coverage and Polygon coverage of currently protected areas

Derive a series of distance grids from resource protected areas (polygons). Each grid is assigned a code (1 = nearest) to 10 (furthest) according to their proximity to these areas.

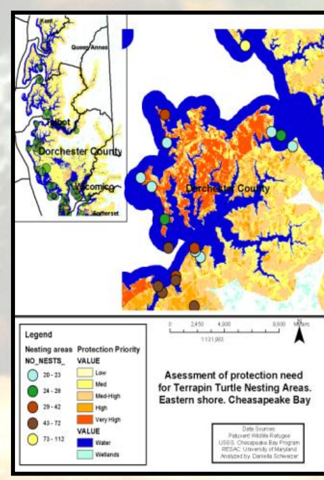
Step VII: FINAL RESULT. Define Nesting Sites Potentially at Risk from Future Land Development .

Layers employed: All layers created in the previous steps.

Combine previously derived GIS information layers. Each layer is weighed according to potential impact on the future availability of nesting sites.

0.4 for nesting areas relative to land use (step 2)
0.7 for proximity of nesting sites to urban development (step 3)
0.7 for land use change over time (step 4)
0.5 for nesting areas falling outside currently protected zones (step 5)
0.25 for distance from protected zones (step 6)

RASTER CALCULATION:
0.40 * (habitat) + 0.7 * (distance) + 0.7*(changed areas) + 0.5 * (unprotected)+ 0.25*(distance from protected zones)



RESULTS: The final result obtained from the raster calculation (Step VII) shows those areas that are of HIGH PROTECTION PRIORITY if terrapin nesting sites are to be maintained in the long-term. High protection priority areas would be those with high values in the calculation. Those areas combine:

- Presence of high number of nests
- Short distance for areas with high population growth pressure
- Change in land use type, between 1990 and 2000, from undisturbed to disturbed.
- Nesting areas that are not currently under protected figures
- Long distance from currently protected areas

The priority areas were mainly localized along the shore in the area of Dorchester County (see map Step VII).

DISCUSSION: From our model of the data collected in Dorchester County, terrapins nesting outside of protected areas and primarily along the shoreline are under high risk of losing their beach sites to intense urban and agricultural development. Without securing sites about which nestlings can successfully hatch and survive, recruitment into the terrapin population could be significantly impacted. The current trends of land management and increased developmental pressure need to be reversed. Although applied to only a limited section of the Bay, the methodology employed in the present analysis proved to be a very effective tool for weighing and prioritizing categories of risk. By integrating layers of geographic information in the form of a raster calculation one is able to better understand the threats and assess the risks that given actions present to the natural resource. As more information become available, additional layers can be integrated, and this database geographically and historically expanded to become an interactive tool for decision making.

CONCLUSIONS: It is now well accepted among natural resource managers that management and conservation of natural resources often require an explicit spatial component. In this study, the integration of various layers of spatial information, such as land-use maps, development pressure and protected areas grids, along with current data on terrapins nesting, assessed quantifiably and reliably, the risk terrapins face from the loss of nesting habitat. Such a spatial analysis, once in place as a GIS project, allows managers to continually update risk analyses and effectively monitor critical wildlife habitat.

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