Marsh Change Analysis in Delaware's Inland Bays, 1937 to 2007

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Center for the Inland Bays
PROTECTING AND PRESERVING DELAWARE'S INLAND BAYS

ABSTRACT

The University of Delaware's College of Earth, Ocean and Environment, in conjunction with the Delaware Center for the Inland Bays, embarked on a project to quantify present and historical marsh changes in the Delaware Coastal Bays. The study area includes Rehoboth Bay, Indian River Bay and Little Assawoman Bay. The three year project focuses on estuarine marshes and contiguous non-tidal wetlands within a three hundred meter buffer around the study area.

The project examines the state of Delaware Coastal Bay wetlands at four dates to determine marsh change: 1937/38, 1968, 1992 and 2007. The first stage of the project looked at 1992 and 2007 State Wetland Mapping Data (SWMP) data to categorize marsh type and determine changes between these two years. From the aerial photography for the two years, we also delineated and quantified marsh areas of fragmented pooling and location of hardened upland/wetland boundary. Changes in the nature of the marsh platform and degree of shoreline hardening can thus be depicted.

We have embarked on the second phase of the project, using aerial photography from the earlier two epochs (1937/38 and 1968) to determine characteristic marsh changes (vegetation, marsh integrity and type, shoreline transgressions, wetland loss/gain, etc.) across a broad time frame. An important step is the vectorizing of 1972 State Wetland Maps (produced by Frank Daiber, see Daiber, et al. and Klemas, et al.) to guide our 1968 wetland classification. Phase two of the project will also map and quantify hardened surfaces and fragmented pooling from the 1968 and 1937/38 aerial photography.

Here we illustrate the marsh change we have identified between 1992 and 2007, including marsh character, fractured pooling, and shoreline hardening across the bay and for selected sub-regions. We also discuss the goals and methods for the second phase of the project, including some of the challenges and limitations of long time-frame change analysis.

Sources:

Daiber, F.C., L.L. Thornton, K.A. Bolster, T.O. Campbell, O.W. Crichton, G.L. Esposito, D.R. Jones, and I .M. Tyrawski. 1976. An Atlas of Delaware's Wetlands and Estuarine Resources. Del. Coastal Mgmt. Program. Tech. Rept. No.2. 528 pp.

Klemas, V., F.C. Daiber, D.S. Bartlett, O.W. Crichton, and A.O. Fornes. 1973. Coastal Vegetation of Delaware. University of Delaware, Newark. 29 pp.

Marsh Surface and Open Water Changes 2007-1992

Using Delaware State Wetland Mapping Data (SWMP) for 2007 and 1992, wetland types were re-classified from the Cowardin-based classifications and merged with Land Cover data to a more useful coding system that suits the Center for the Inland Bays needs for the project (See Table 1). Non-natural channels and ditches were cut-off from the main bays in order to distinguish specific types of tidal water. Figure 1 shows the changes in wetland types and surface land cover types between 2007-1992 according to the SWMP and Land Use/Land Cover data.

High Marsh	Scrub Shrub/Forested Salt Marsh	Emergent Salt Marsh	Marsh Pond/Mudflat	Marsh Open Channel	Boat Basin
Marsh Impoundment	Marsh Ditch	Tidal Canal	Open Bay	Marine	Tindal Shoreline
Tidal Freshwater Wetland, Emergent	Tidal Freshwater Wetland, Scrub Shrub	Tidal Freshwater Wetland, Forested	Non-tidal Freshwater Wetland, Emergent	Non-tidal Freshwater wetland, Scrub Shrub	Non-tidal Freshwater Wetland, Forested
Forest, Deciduous	Forest, Evergreen	Forest, Mixed/Other	Agricultural	Developed	Transitional
Lakes and Ponds	Wetland, Farmed	Reservoir/	Non-tidal Shoreline	Beach	Dune Complex

Table 1

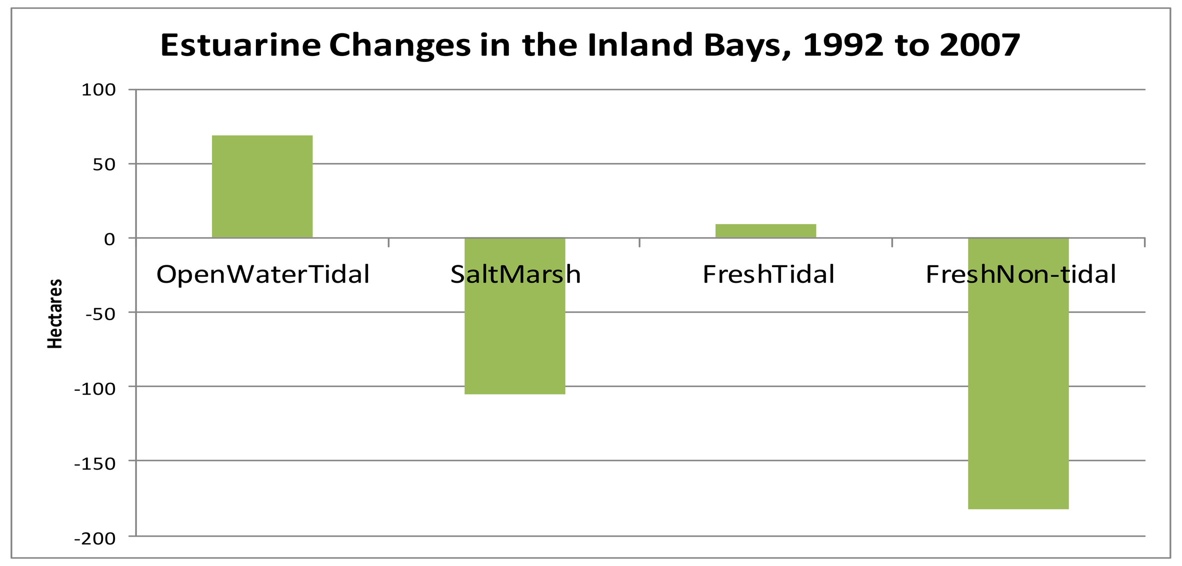


Figure 1

Figure 1: This chart shows the gains and losses according to the SWMP 2007 and 1992 data according to the newly-defined classes (See Table 1). Losses were seen in Emergent Salt Marshes and Freshwater Non-Tidal Wetlands. Gains of Open Water Tidal may be signs of shoreline loss and sea level rise between 1992-2007. Figures 2 and 3 show the specific areas of high losses and gains of emergent salt marshes in the Inland Bays.

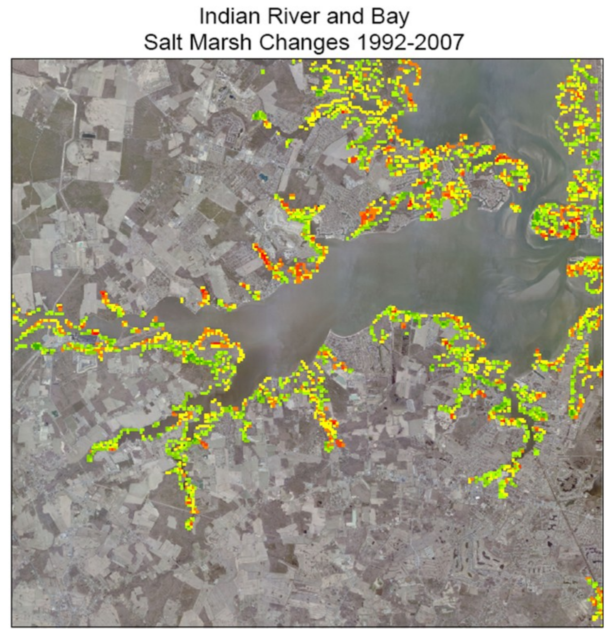


Figure 2

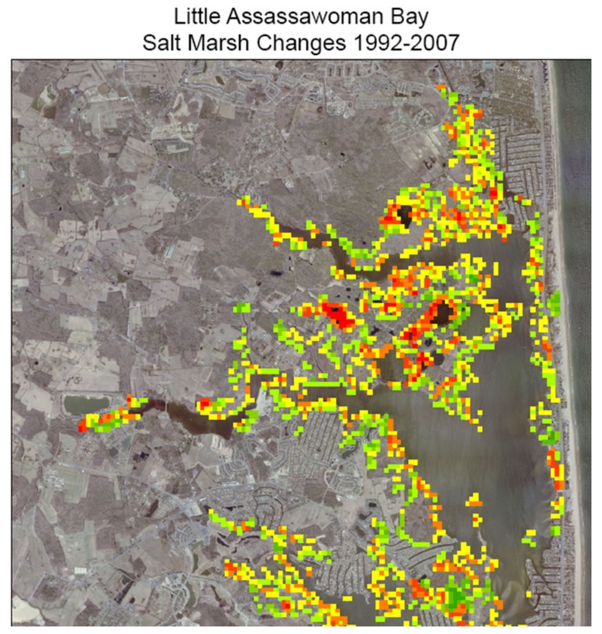
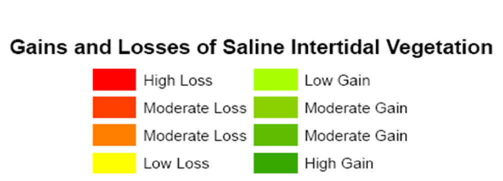


Figure 3

Figures 2 & 3: These maps show the gains and losses of emergent salt marshes throughout the Delaware Inland Bays. Areas of red delineate salt marsh loss between 1992-2007. Areas of gains are shown in green in emergent salt marshes



1972 State Wetland Mapping (From Daiber, *et al.*)

Historic Mylar maps were vectorized in order to create a layer file of the 1972 Delaware State wetlands (See Figure 4). The Mylar maps were delineated by their dominant vegetation. Using this classification system, individual codes were given to each polygon to identify the plant type that was prevalent in 1972.

We can use the identified shoreline and upland boundaries as independent interpretations of the dynamic changes of the historic extent of the wetland. We will use these shoreline and upland boundary lines in our historic analysis of the 1937/38 and 1968 aerial photography.

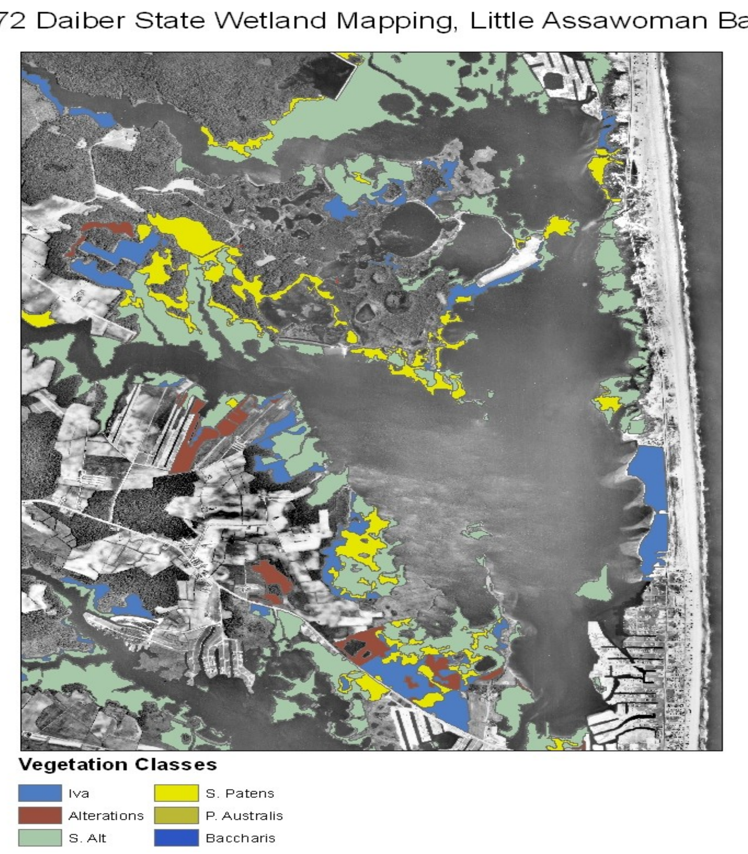


Figure 4

Stressor Abundance

Fractured pooling and hardened surfaces are quantified over a 6m x 6m resolution and then aggregated into a larger 60m x 60m grid cell to determine their extent and location for each epoch.

Fractured Pooling – defined as surficial "open water" lying on the marsh surface that is not identified as open water.

Hardened Surface – measured along the wetland boundary and is classified as any non-natural armored surface that may impede the ability of the wetland to migrate landward.

Methods: A raster-based binary classification scheme was used to indicate the presence of a stressor (employing a "raster painting" technique). Figures 5-7 illustrate how the "painted" stressor areas were delineated and measured within the 60m x 60m resolution grid cells (in yel-

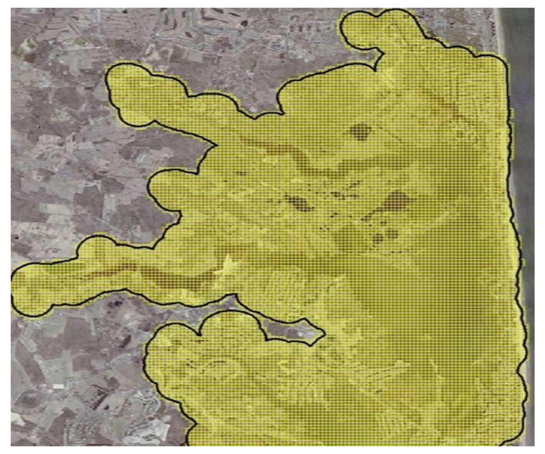


FIGURE 5

FIGURE 6

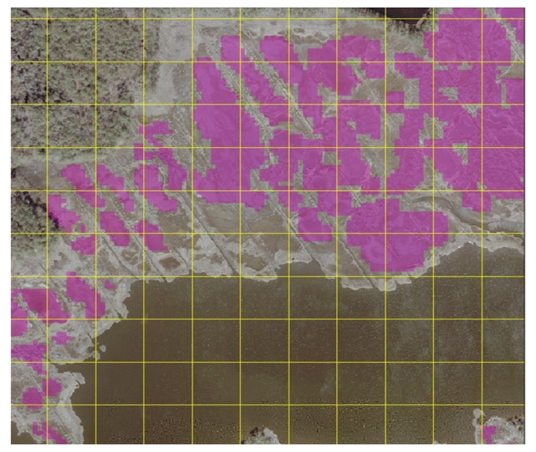


FIGURE 7

Figure 5 is a map of the Inland Bays of Delaware with the aggregation grids overlaid. These 60mx60m cells are used to quantify aggregate stressor abundance throughout the study area. The method is employed for both hardened surfaces and fractured pooling. Figure 6 shows an area of emergent salt marsh with surficial open water. Figure 7 shows the same area with surficial open water indicated in pink ("painted" using raster tools in ArcGIS) and quantified within the grid cells (yellow boxes)

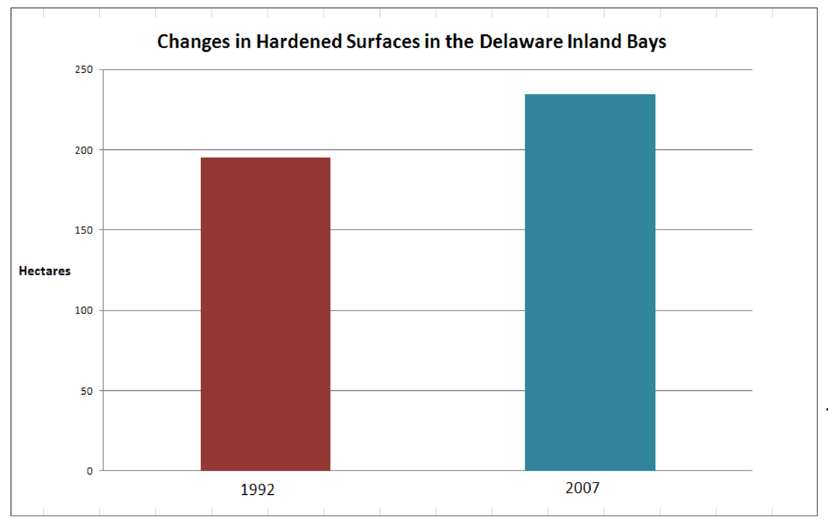


FIGURE 8

Figure 8: Between 1992 and 2007, the Delaware Inland Bay's saw an increase of ~40 hectares of hardened surfaces along the wetland boundaries. Using the 2007 shoreline as the baseline for all time series, any non-natural structure along the boundary is captured by using the raster painting tool within the 6m x 6m resolution grid cells

Continuing Work

- **Historic Stressor Analysis**

The next phase in the project consists of quantifying the stressors for the remaining two time epochs: 1968 and 1937/38. We will be using the Daiber 1972 State Wetland Maps and the 1992 SWMP data as a baseline in order to calculate the historic stressor data as well as the shoreline and upland boundaries.

- **LANDSAT analysis**

Compares above ground biomass among pairs or years and adjusts for changes in atmospheric conditions and seasonal growth by wetland type. Four pairs of data will be used to calculate the standard score of the greenness index. Images were selected by their proximity to low tide.

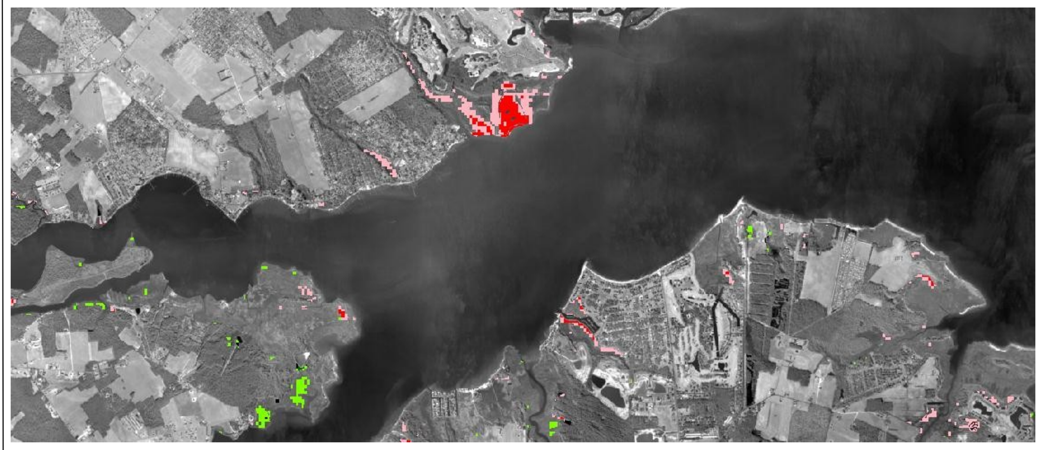


FIGURE 9

Figure 9: The areas in light (±1-2 sig. difference) and dark red (>2 sig. difference) show moderate and high losses, respectively, of above ground biomass. This area is particular dynamic, because at various time intervals, the greenness recovers and shows moderate and high gains of the above ground biomass. The particular image shows a five year interval (10/87-6/92).

Acknowledgments

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