
Credit: Kimberly Manzo

Eelgrass Loss

Predicting eelgrass decline in southern MA from anthropogenic impacts

What is Eelgrass?

Zostera, the genus of seagrass also known as eelgrass, is a keystone species that grows in soft-bedded intertidal zones. Eelgrass retains coastal sediment and supports waterfowl, fish, and shellfish. These habitats have been shrinking, and in 2009 the global rate of eelgrass loss was 3.7 percent per year. In the Great Bay Estuary, NH, eelgrass cover decreased an average of 2.2 percent per year from 1996 to 2016 (Figure 1).

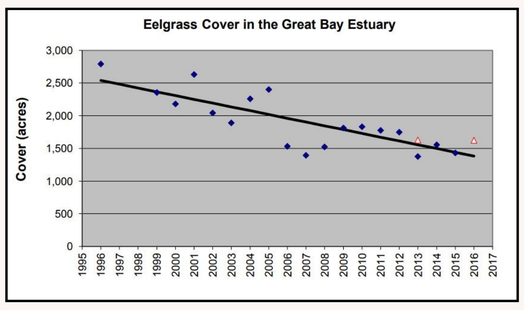

Figure 1: Great Bay Estuary Eelgrass Decline (Piscataqua Region Estuaries Partnership, 2017)

Why is it declining?

The steadily increasing impact of human activities is linked to eelgrass habitat loss. Degraded water quality and physical disturbance, such as from fishing and dredging, disrupt the beds and reduce their ability to recover from the stress of natural events like storms. Restoration projects have seen success, however, and identifying the most vulnerable areas could help towards preventing severe habitat loss.

Figure 2: Study Area

MA Eelgrass Loss

This project attempted to use anthropogenic impact to identify vulnerable eelgrass habitats. The accuracy of the results was judged through comparison with habitat loss observed by the Massachusetts Department of Environmental Protection's (DEP's) eelgrass mapping project. The area of analysis, as displayed in figure 2, surrounds the Cape Cod region of Massachusetts.

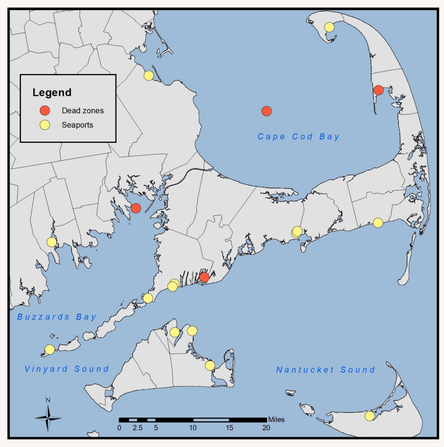

Figure 3: Seaports and Dead Zones

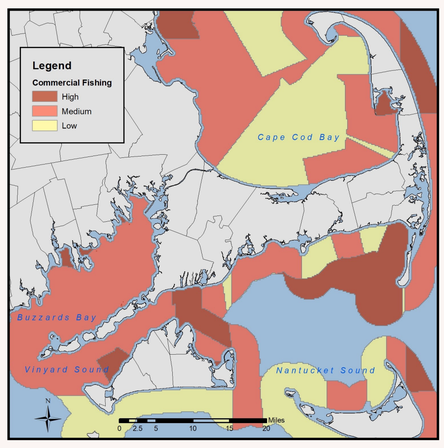

Figure 4: Commercial Fishing Activity

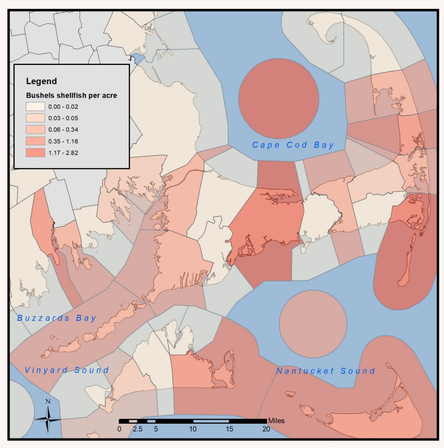

Figure 5: Mean Annual Shellfish Catch

Methodology

To identify observed eelgrass change, a union overlay was performed from the 2017 to the 1995 DEP eelgrass polygons. Areas gained and lost were identified through selection by attributes.

The data sets used to quantify anthropogenic impact include dead zones, seaports, commercial fishing activity, and mean annual shellfish catch (figures 3–5, respectively). The dead zones represent water quality, and the other three represent physical disturbance. Relative impact was estimated by adding together classified raster layers produced from this data.

A 5-meter raster cell size was used, because the DEP eelgrass polygons were created from images with a 0.25-meter pixel size. The rasters were too large for a weighted overlay and caused the tool to crash. To achieve an equally-weighted overlay, the rasters were added together with the plus tool.

GPS locations of recurring dead zones were identified from a 2011 World Resources Institute review of reported eutrophic and hypoxic zones. Buffers were clipped to the ocean and converted to raster. The largest dead zone was 12 km^2, so a 2-km buffer was chosen as the range of impact.

The seaport locations were rasterized with a buffer distance of 3 kilometers. This distance is an estimated range of impact for ships travelling to and from ports.

Feature class polygon layers containing commercial fishing intensity and annual shellfish catch were classified on a scale from one to three. Shellfish harvest was measured as mean annual bushels per acre.

The total impact scale ranged from zero to six. The zonal statistics tool was used to compute mean impact over the DEP eelgrass polygons. Impact was classified from low to high at intervals of two

Results

The relative anthropogenic impact is mapped below in figure 7. When compared with eelgrass loss mapped by the DEP (figure 6), areas of high and medium impact correlate with many of the eelgrass habitats that were lost between 1995 and 2017. The analysis did not measure above low impact for many small habitats close to land that were lost, however.

This could be due to other factors, such as sewage outfalls or construction activities, which could mobilize sediment and impair water clarity. Overall, this analysis identified the largest lost eelgrass habitats as facing medium or high impact. Further analysis could consider which areas would ecologically benefit the most from eelgrass restoration.


Credit: Niantic River Watershed

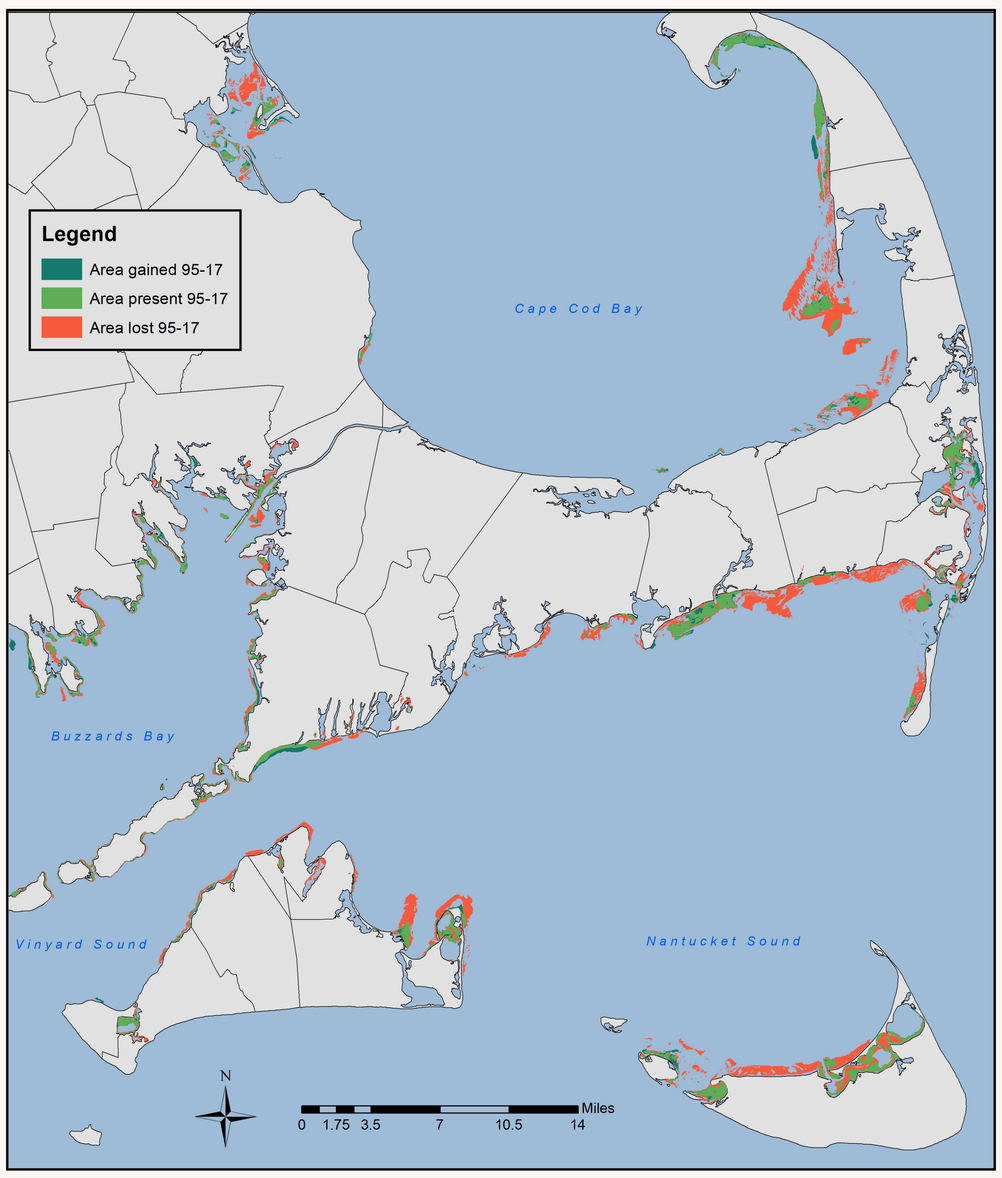

Figure 6: Observed Eelgrass Area Change from 1995 to 2017

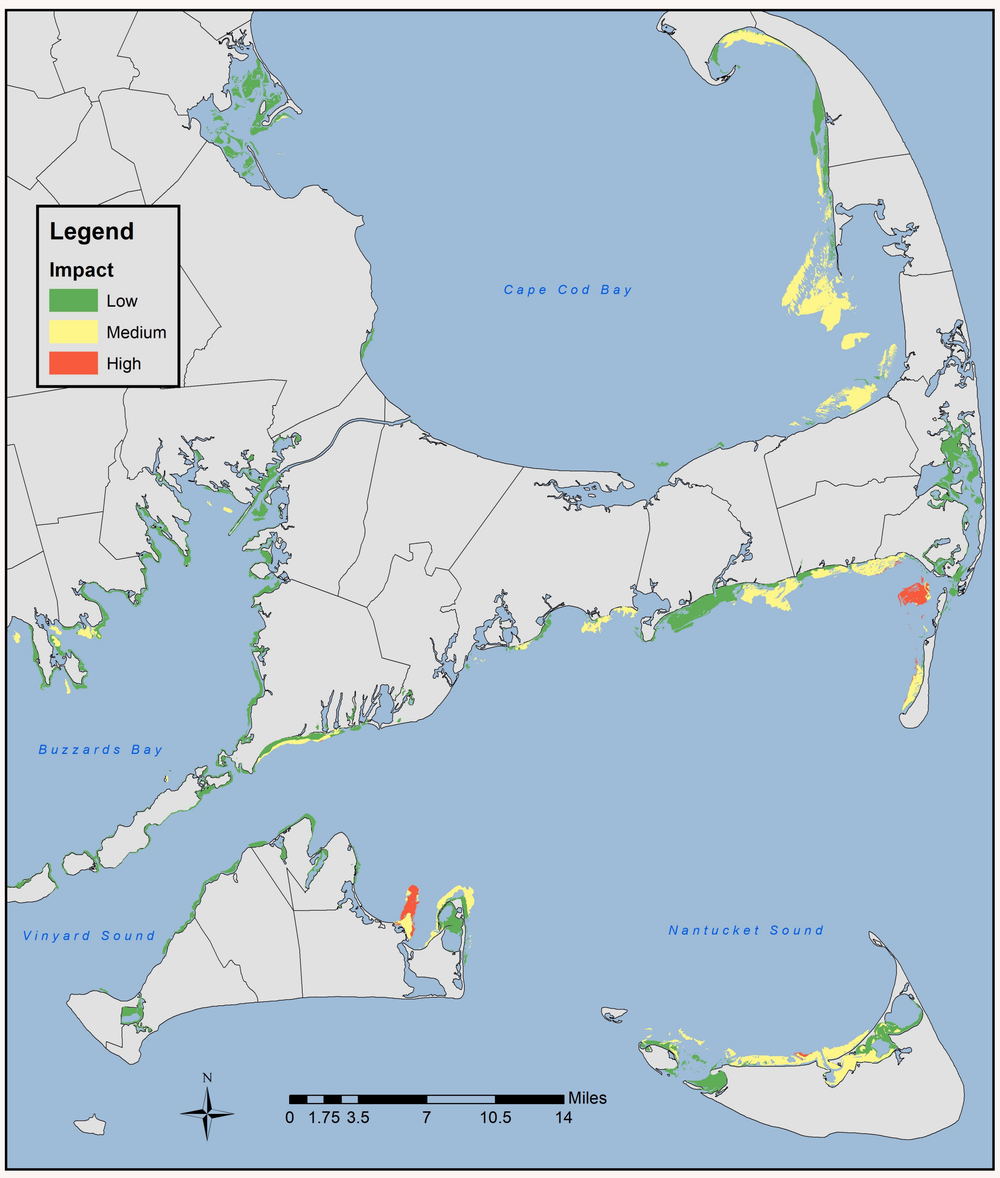

Figure 7: Predicted Degree of Anthropogenic Impact on Eelgrass

Data Sources

MA Department of Environmental Protection
MA Department of Transportation
MA Division of Marine Fisheries
MA Office of Coastal Zone Management
MA GIS
World Resources Institute; R. Diaz, M. Selman, and C. Chique

Projected Coordinate System:

NAD 1983 Massachusetts State Plane Mainland (FIPS 2001, Meter)

Geographic Coordinate System:

GCS North American 1983

Citations:

"Bay Scallops on Eelgrass." *Niantic River Watershed.* https://www.nianticriverwatershed.org/homeowner-programs/.

Manzo, Kimberly. "Juvenile fish seek refuge from predators in eelgrass meadows." *Cornell Cooperative Extension Suffolk County*, 6 Sep. 2017, http://ccesuffolk.org/marine/habitat/eelgrass-restoration-and-monitoring.

Picture of Common Eelgrass. *Cumbria Wildlife Trust, Ltd.* https://www.cumbriawildlifetrust.org.uk/wildlife-explorer/mauinosh/marine/seaweeds-and-seagrass/common-eelgrass.

Piscataqua Region Estuaries Partnership, (2017). *PREP Environmental Data Report, December.* https://www.stateofourestuaries.org/wp-content/uploads/2017/12/eelgrass.pdf.

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Geographic Information Systems, CEE-187, Spring

Civil and Environmental Engineering

Credit: Cumbria Wildlife Trust