Changes in belowground roots, rhizomes, and respiration in coastal wetlands in urbanized northeastern USA estuaries

[1]Wigand, C., [1]Watson, E., [1]Davey, E., [1]Johnson, R., [2]Roman, C., [3]Maher, N., [4]Warren, S., [5]Johnson, D., and [5]Deegan, L.

[1]US EPA NHEERL, Atlantic Ecology Division, 27 Tarzwell Drive, Narragansett, RI 02882.
[2]National Park Service, University of Rhode Island Bay Campus, South Ferry Road, Narragansett, RI 02882.
[3]The Nature Conservancy, Long Island, Cold Spring harbor, NY, 11724
[4]Connecticut College, Department of Botany, New London, CT 06320
[5]The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA 02543

Many organic-rich salt marshes in the northeastern USA are disappearing at an alarming rate. In the Jamaica Bay Estuary (NY), marshes are reported to be eroding at approximately 14-16 hectares per year. These losses are due to multiple stressors, including sewage effluent inputs, changes in hydrodynamics due to dredging activities, and accelerated sea level rise due to global warming. In a large-scale, long term, fertilization experiment, marshes in the Plum Island Estuary (MA) received nitrogen and phosphorus additions, increasing the flooding tide nutrients 15-20x over background. We used computer-aided tomography (CT) imaging to quantitatively characterize both salt marsh soils. We found significant differences between the Jamaica Bay disappearing and stable marshes in mass, density, and diameter of roots and rhizomes with the CT imaging. There were significantly lower abundances and masses of roots and rhizomes in the disappearing Jamaica Bay marshes. Surprisingly, the diameters of the roots and rhizomes in the disturbed marshes were significantly greater than in the stable marshes. In the Plum Island fertilization experiment, we found similar results of significant losses in belowground biomass and changes in the peat quality in the fertilized marshes compared to control. We observed large scale erosion at the fertilized Plum Island sites. In situ soil respiration rates were significantly higher in the disappearing Jamaica Bay salt marshes and the Plum Island fertilized creeks than in the stable or control marshes. We saw a similar response of increasing marsh soil respiration rates with increases in watershed nitrogen loads in the urbanized Narragansett Bay Estuary (RI) and Long Island (NY) coastal systems. The changes in the belowground structure and respiration in disturbed salt marshes reduces the stability of the marsh platform, and makes it more susceptible to storm surges and erosional processes.