

Assessment of Roots, Rhizomes, and Soil Respiration in Disturbed, Organic-rich Salt Marsh Soils

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Background/Question/Methods Accelerated sea level rise and cultural eutrophication are anthropogenic stressors known to alter the structure and function of salt marsh ecosystems. Many salt marshes in Jamaica Bay (NY) are reported to be disappearing at an alarming rate, approximately 35 - 40 acres per year. It is suspected that these losses are due to multiple anthropogenic stressors, including accelerated sea level rise due to global warming and cultural eutrophication. A novel approach to utilize computer-aided tomography (CT) imaging to characterize salt marsh soils was developed, and it requires adding 5 calibration rods (air, water, 34% and 50% colloidal silica, and solid glass) to the marsh cores prior to imaging to define the soil fractions of interest. The roots and rhizomes in disappearing and stable marshes in Jamaica Bay were examined and quantified using this CT imaging method. To validate the CT imaging method, roots and rhizomes were hand-sieved (material retained on a 0.5 mm sieve), and regression analysis showed a significant ($P < 0.05$) relationship between the hand-sieved roots and rhizomes and the CT imaging estimates of roots and rhizomes. Significant differences between the disappearing and stable marshes in mass, density, and diameter of roots and rhizomes as quantified with the CT imaging method were detected. There were significantly ($P < 0.05$) less roots and rhizomes and lower mass of roots and rhizomes in the disappearing marshes. Surprisingly, the diameters of the roots and rhizomes in the disturbed marshes were significantly greater ($P < 0.05$) than in the stable marshes. In addition, in situ soil respiration rates were significantly higher ($P < 0.05$) in the disappearing Jamaica Bay salt marshes than in the stable marshes.

Results/Conclusions These changes in the belowground structure and processes in disturbed salt marshes might reduce the stability of the marsh platform, and make it more susceptible to storm surges and erosional processes. Monitoring belowground structure of salt marshes may provide potentially vital information on the health of salt marsh ecosystems. Use of CT imaging to assess roots and rhizomes is a rapid and practical approach to assess anthropogenic effects on wetland soil structure.

Key Words: salt marsh; computer-aided tomography; Jamaica Bay; sea level rise; eutrophication; global warming; belowground structure; roots; rhizomes