Great Bay National Estuarine Research Reserve

Graduate Research Fellowship Project

Climate Impacts and Adaptation

EFFECTS ON SALTMARSH MICROBES

THREATENED BY CHANGE?

Seven to twenty-three inches. According to a 2007 report of the Intergovernmental Panel on Climate Change, by 2100 worldwide sea level is projected to increase by that much! And that's a conservative estimate because the *rate* of sea level rise is likely to increase over that time period as well. If accurate, shores and salt marshes that fringe the Great Bay estuary will be increasingly inundated

Compounding the impact of sea level rise, increasing human activity in the Great Bay watershed has led to another growing problem – nutrient pollution. In the 45 New Hampshire and Maine communities within the watershed, population size grew by more than 80% from 1980 to 2008. Nitrogen concentrations in the estuary are estimated to have increased by 44% over a similar timeframe from increased development, runoff, and wastewater discharges related to population growth. Although nutrients like nitrogen and phosphorus are essential to productive estuarine ecosystems, excessive amounts can have harmful consequences.

NOAA and the Great Bay National Estuarine Research Reserve (GBNERR) have selected Matt Simon, a master's student at the University of New England, to study these combined climate change and nutrient impacts in the estuary. Specifically, he will focus on a little studied, but vastly important, aspect of salt marsh ecology – the microbial activity that occurs in the soil and how it might adapt to these changes.

WHY ARE MICROBES SO IMPORTANT TO MARSH HEALTH?

Microbes break down organic matter in marsh sediments, thus contributing to a natural cycle of change in marsh surface elevation. While erosion and deposition (accretion of sediments and live and decaying vegetation) are dominant controlling factors, the rate of microbial activity is less well known. The concept is relatively simple – the decomposition of material by microbes causes a decline in marsh elevation; in areas where there is little microbial decomposition to offset deposition, the elevation may increase or not decline as much. Consequently, microbial activity plays a potentially important role in marsh elevation and whether it will keep pace with sea level rise. The viability of a salt marsh, especially with respect to the impending environmental changes that are facing our coastal areas, depends on this delicate balance.

FAST FACTS:

Project Title:
The Effects of Anthropogenic Change on Salt Marsh Microbial Structure and Function

Project Duration:
6/1/2012 to 5/30/2013

Project Partners:
University of New England
New Hampshire Fish & Game
University of New Hampshire
NOAA/NERRS

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GREAT BAY NATIONAL ESTUARINE RESEARCH RESERVE

UNE UNIVERSITY OF NEW ENGLAND

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

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PROJECT GOAL:

Expand our understanding of saltmarsh microbial community structure and function and response to impending sea level rise and increasing levels of nutrient pollution

The repercussions of human activities may combine (or counteract each other) to yield unexpected effects of altered microbial activity on saltmarsh resiliency to change. This understanding will inform management decisions by:

1) Guiding short-term management decisions on saltmarsh preservation more effectively through improved understanding of ecological responses to stress; and
2) Shaping long-term management goals and activities through a better understanding of environmental changes and adaptation management tools that will build saltmarsh resiliency against change.

PROJECT APPROACH:

Field and laboratory experiments will assess the functionality and structure of the microbial community in the soils of Bunker Creek marsh on the Great Bay estuary.

Community Function:

A series of marsh soil samples will be collected, each representing a different tidal elevation, and isolated in "microbial cages" composed of bags made of dialysis tubing. The tubing allows ambient water and solutes to enter while restricting the transfer of microbes in or out. The cages will also contain a carbon-based decomposition disc for a period of about 10 days. The decomposition discs will be weighed before and after the exposure period, and weight changes correlated to long term decomposition rates, a measure of change in community function. In the laboratory, the microbial cages will be exposed to simulated sea level rise and external nutrient loading (using varying levels of nitrogen and/or phosphorus). Instantaneous decomposition rates can be directly measured with analytical equipment multiple times in the lab as well as using the discs.

Community Structure:

Changes in the structure of each microbial community will be determined by comparing their genetic diversity patterns. A molecular analysis, called terminal-restriction fragment length polymorphisms (t-RFLP), will cut DNA strands of known length into smaller fragments, which can then be sequenced and labeled into diversity patterns. Statistical analyses are used to reveal genetic differences among sample sites in the field and between sea level and nutrient treatments in the laboratory studies. Each field and laboratory treatment and controls will be analyzed pre- and post-experiment to determine test condition effects on community structural changes.

The Graduate Research Fellowship Program of the National Estuarine Research Reserve System provides young scientists with resources to conduct original research relevant to coastal and estuarine sciences leading to more informed resource management decisions and training. Find out more at: http://nerrs.noaa.gov/

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