6-1-2006

Water Resources Research Center Annual Progress Report: Effects of vegetated buffers on the salt marsh plant community

New Hampshire Water Resources Research Center (NH WRRC)

Water Resources Research Center Annual Progress Report
June, 2006

Project Title: Effects of vegetated buffers on the salt marsh plant community

Grant: 15024-2001 Water Resources Research, #115052
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Problem statement

Replacement of natural vegetation with agriculture and residential land use within the watershed of an estuary is known to impact the integrity of the estuarine ecosystem. Vegetated buffer strips are recommended to reduce the impacts of these land uses on the estuary. However, specific responses within the salt marsh plant community to varying widths and types of vegetated buffers are unknown.

Knowledge of the effect of buffer width and type on the adjacent salt marsh plant community will inform best management practices for shoreline property owners and land managers, will help town planners with ecologically sound review of coastal development plans, and will help justify and strengthen guidelines for shoreline protection.

This project is designed as three independent investigations into the possible effects of natural buffers on 1) the salt marsh plant community; 2) the shallow groundwater chemistry, and; 3) the leaf tissue chemistry of a species of high salt marsh plant.

Methods

Plant community analysis

The buffer of natural vegetation between salt marshes around the Great Bay and residential and agricultural land uses was digitized from aerial photography using a geographic information system (GIS). Sites were identified with varying buffer width appropriate for further ground-based study. Appropriate sites were determined to be any contiguous marsh shoreline with at least 75m of edge in each of the following three buffer width categories: 0m; 1-20m; 21-100m. Plant communities of five sites were inventoried in the summer of 2005. At each site, a 50m transect was set up along the marsh/upland ecotone running parallel to the upland edge. A 1x1m quadrat was placed at every 10m interval along the transect. A percent cover was assigned for all plant species occurring within the quadrat, and soil pore water salinity measured.

Groundwater nitrogen analysis

Groundwater wells were installed at two farms on the shores of Great Bay. Sets of groundwater wells were placed at the upper and lower edges of 2-3 different buffer widths at each farm. Groundwater was collected from the wells monthly provided the water table was high enough. Upon arrival at each site, each well was bailed dry and allowed to recharge. From each well 60mL of filtered water was collected and frozen until future analysis by the Water Resource Research Laboratory at the University of New Hampshire for ammonium, nitrate, and total dissolved nitrogen.

Leaf tissue nitrogen analysis

Two sets of fertilized and control plots were set up on the salt marsh edge at each farm, one set where no buffer was present, and one set adjacent to a vegetated buffer. Plots were fertilized every two weeks with 60g/m2, 29-3-4 N:P:K, Scott's Turf Builder fertilizer between May and July, for a total of 6 applications. Two weeks following the final fertilizer application, the youngest fully expanded leaf of one stiff-leaved quack grass (*Agropyron pungens*) was collected from each fertilized and control plot and analyzed for N content.

Preliminary Results

Plant Community Analysis

Vegetation data was collected from the following five sites. An additional four sites will be surveyed in the summer of 2006. Data analysis for the plant community assessment will begin by December 2006.

Site	# transects	Date collected
White Marsh	*3*	*Sept 2005*
Bellamy	*3*	*Aug 2005*
Mill River	*3*	*Aug 2005*
Lubberland	*3*	*Aug 2005*
Wiggin Farm	*3*	*Sept 2005*
Stuart Farm N	*3*	
Stuart Farm S	*3*	
Pickering	*3*	
Chapmans Landing	*3*	

Groundwater Chemistry Effects

Groundwater wells were set up at both farms in May of 2005. Three buffer widths were selected at Wiggin Farm. Wells were set up in sets of three at the upper and lower edges of each buffer width, for a total of 18 wells at Wiggin Farm. Two buffer widths were selected at Stuart Farm, including one area where no buffer exists. A total of 9 wells were set up at Stuart Farm. An effort was made to collect groundwater from every well each month. However little rainfall in the late summer through fall of 2005 meant that

the water table dropped significantly, and often the wells were dry. Monthly well water collection began again in March of 2006 and is anticipated to continue until September of 2006.

Month / Year	*Site*	*# wells collected*	*Site*	*# wells collected*
June / 2005	*Wiggin*	*17*	*Stuart Farm*	*9*
July / 2005	*Wiggin*	*14*	*Stuart Farm*	*8*
August / 2005	*Wiggin*	*11*	*Stuart Farm*	*7*
November / 2005	*Wiggin*	*18*	*Stuart Farm*	*9*
March / 2006	*Wiggin*	*7*	*Stuart Farm*	*6*
April / 2006	*Wiggin*	*13*	*Stuart Farm*	*9*
May / 2006	*Wiggin*	*17*	*Stuart Farm*	*9*

Preliminary results suggest that there is a buffer effect on the concentration of groundwater nitrogen. Although only total dissolved nitrogen ($F = 4.95$; $p = 0.029$) and dissolved organic carbon ($F=6.36$; $p = 0.013$) concentrations were found to be significantly different between the upper and lower wells, all concentrations of the different nitrogen species were higher in the upper wells and lower in the lower wells, and data for NO3 ($F=3.79$; $p = 0.055$) and NH4($F = 3.59$; $p = 0.061$) were nearing significance. I anticipate an additional year of data collection will more solidly demonstrate a buffer effect on groundwater chemistry.

Leaf Tissue Effects

A split-plot ANOVA of the first year of data suggests there is no difference between the percent of nitrogen in leaf tissue from fertilized and control plots regardless of the presence or absence of a natural buffer ($F = 0.029$, $p=0.86$). It is unknown how fast the plants within the fertilized plots will respond to the fertilizer applications. Therefore, a second year of plot fertilization and data collection is more likely to detect any changes in the plant tissue chemistry.

Publications, presentations, and awards

- N/A

Number of students supported

- One Masters student (no stipend, but materials and analyses)
- One undergraduate student, partial support

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