Nutrient enrichment alters soil geochemistry leading to marsh loss in coastal ecosystems

J. W. FLEEGER[1]*, D. S. JOHNSON[2] AND L. A. DEEGAN[2]

[1]Department of Biological Sciences, Louisiana State University, Baton Rouge, LA 70803 (*Correspondence:zoflee@lsu.edu)

[2]The Ecosystems Center, Marine Biological Laboratory, 7 MBL Street, Woods Hole, Massachusetts 02543

Salt marshes are productive coastal wetlands that provide important ecosystem services such as storm protection, nutrient removal and carbon sequestration. Despite protective measures, however, worldwide losses of these ecosystems have accelerated in recent decades. Here we present data from a nine-year, whole-ecosystem nutrient-enrichment experiment. Our study demonstrates that nutrient enrichment can lead to saltmarsh loss. We show that nutrient levels commonly associated with coastal eutrophication increased above-ground biomass of marsh-edge *Spartina alterniflora*, decreased the dense, below-ground biomass of bank-stabilizing roots, and increased microbial decomposition of organic matter. Soil organic matter dercreased in quantity and size, and soil water content increased. These alterations in soil geochemistry reduced geomorphic stability resulting in creek-bank collapse with significant areas of creek-bank marsh converted to unvegetated mudflat. This pattern of marsh loss parallels observations for anthropogenically nutrient-enriched marshes worldwide, with creek-edge and bay-edge marsh evolving into mudflats and wider creeks. Our work suggests that current nutrient loading rates to many coastal ecosystems have overwhelmed the capacity of marshes to remove nitrogen without deleterious effects.

Projected increases in nitrogen flux to the coast, related to increased fertilizer use, may rapidly result in a coastal landscape with less marsh, which would reduce the capacity of coastal regions to provide important ecological and economic services.