The Effects of Invasive Grasses on Ecosystem Function

of a Freshwater Marsh and Estuarine Marsh

This is the dissertation research of my graduate student, Lisa Turnbull, funded by a National Oceanic and Atmospheric Administration (NOAA) graduate fellowship. We are examining the role of an invasive seagrass, *Zostera japonica,* and an invasive freshwater grass, *Phalaris arundinacea,* on ecosystem properties and function in the South Slough National Estuarine Reserve in Charleston, OR.

Phalaris arundinacea, reed canary grass, is an invasive grass in freshwater wetlands over much of North America. *P. arundinacea* is a dominant competitor due to its efficient use of nutrients for growth, high aboveground biomass, and large reproductive capacity, either clonally or through large numbers of seeds. On the west coast, *Zostera japonica,* dwarf eelgrass, forms dense patches in the mid-intertidal zone. In the absence of *Z. japonica*, this zone is often unvegetated. *Z. japonica* invasion increases faunal abundance, which can affect bioturbation and hence soil function. *Z. japonica* also alters nutrient fluxes from the water column into the benthos; however, more research is necessary to better understand the ecosystem effects of this species.

Question 1: How does *P. arundinacea* affect soil nutrient and carbon cycling and retention? *P. arundinacea* can have a variety of effects on soil structure and function because of the thick thatch layer and its effect on soil temperature, changes in litter quality and hence nutrient mineralization, high productivity, belowground and aboveground allocation patterns, and changes in reduction-oxidation (redox) status through radial oxygen loss from roots.

Question 2: How does *Z. japonica* affect sediment accretion and nutrient and carbon cycling and retention? Sea grasses have been found to be major sinks and sources of nutrients and are known to have significant effects on accretion. They alter sediment chemistry because they can release oxygen into the sediment through their roots and through changes in invertebrate communities.

Question 3: Are changes in soil functioning due to the invasion of *Z. japonica* reversible following the removal of the invasive species? Other studies have suggested that vegetation shifts in marshes will lead to ecologically significant changes in nutrient cycling.

The South Slough NERR is an ideal site to address these questions. There are areas that have been invaded by *P. arundinacea* or by *Z. japonica*, each with nearby non-invaded areas that can be used as controls or as areas these species can be planted. Also, since the freshwater and mesohaline marshes are in a relatively close proximity, we will make a qualitative comparison as to whether position along an estuarine salinity gradient influences the effects of invaders or their removal on soil processes. Invasive species are a major problem in wetland restorations, and the South Slough NERR allows us to address the effects of invasive species in both natural and restored wetlands.

There are three distinct experiments as part of this project: (i) a plant removal and addition experiment for *Z. japonica* in a restored salt marsh, (ii) a comparison of paired plots with and without *Z. japonica* along an estuarine gradient covering several miles, and (iii) a comparison of paired plots with and without *P. arundinacea* in a freshwater marsh. In all experiments, a variety of plant and soil ecosystem responses are being measured.