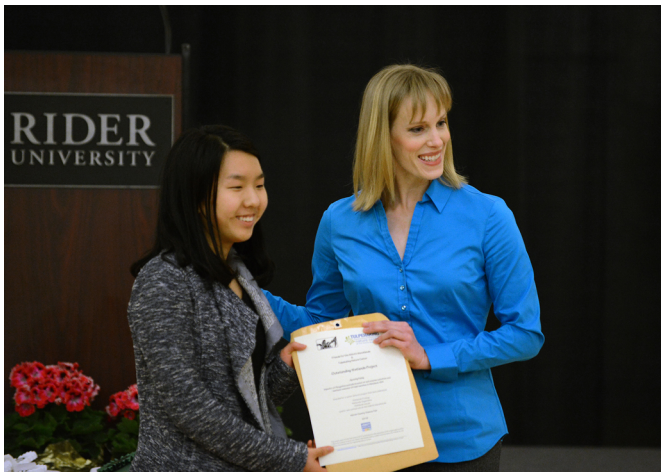

Abbott Marshlands Wetlands Award – March 15, 2016

The winner of the Abbott Marshlands Wetlands Award given at the 2016 Mercer County Science Fair was Jiyoung Kang a Princeton HS junior. The title of her project is: 'Impacts of *Phragmites australis* invasion on soil enzyme activities and methane emission of tidal marshes in Maryland, USA. The monetary award ($100) is awarded to a project that best addresses: wetland ecology, wetland organisms, wetland issues and/or was carried out at the Abbott Marshlands. This award is intended to raise awareness of the unique opportunities offered for science study at the Abbott Marshlands and is a collaboration between the Friends for the Abbott Marshlands and the Tulpehaking Nature Center

Winner Jiyoung Kang with presenter, Tulpehaking Nature Center Manager Kelly Rypkema. Photograph: Peter Borg, Rider University

Abstract

Project Title:	Impacts of *Phragmites australis* invasion on soil enzyme activities and methane emission of tidal marshes in Maryland, USA
Student:	Jiyoung Kang
Division:	Senior
Category:	Earth and Environmental Sciences

Salt marshes are coastal wetlands that are influenced by tidal flows. They are of great importance in carbon storage, water quality improvement, wildlife habitat conservation and coastal protection. Recent years have witnessed invasion and expansion of *Phragmites australis* in marshes in the East coast of the United States. This has drawn much attention, because it may change vegetation diversity and ecosystem functions. In particular, higher primary production of Phragmites than that of other native species such as *Spartina paten*s and *Scirpus americana* has been noted, suggesting possible changes in carbon storage potential in salt marshes. However, to better understand the long-term effect of the invasion on carbon storage in tidal marshes, two types of ecosystem processes should be clearly revealed. First, decomposition of soil organic matter (SOM) in the system should be examined because this will determine carbon accumulation rates. SOM decomposition is directly mediated by extracellular enzymes produced by microbes in soil. Secondly, wetlands can release methane (CH4), a 25-time stronger greenhouse gas than CO2, which is produced by anaerobic microbes named methanogen. As such, we can accurately predict the effects of *Phragmites* expansion on a carbon budget in tidal marshes by fully understanding its decomposition and methane

dynamics. To address those issues, I measured extracellular enzyme activities and fungal abundances in different depths of soils dominated by three different vegetation types. In addition, CH4 emission and methanogen abundance were measured by a static chamber method and real time qPCR, respectively. Stable isotopic signatures (C and N) of soil organic matter and fresh leaves were also measured by isotope ratio mass spectrometry. The activities of β-glucosidase and phenol oxidase in near surface were lower in *Phragmites*-dominated soil than in *Spartina*-dominated soil, but no discernible trend was found for fungal biomass. Stable isotopic signature suggests that only the surface soil is affected by *Phragmites* leaves while the deep soils exhibit a similar property with *Spartina* leaves. CH4 emission was higher in *Phragmites*-dominated sites than *Spartina*-dominated sites. Higher abundance of methanogen was found in *Spartina*-dominated soil in near surface, but deep soil showed an opposite trend. Overall results of this study indicate that *Phragmites* invasion can impede the decomposition of organic matter near surface soil. However, the invasion may accelerate CH4 emission which is due to activation of methanogen in deep soil.