

Controlling Agricultural Nutrient Runoff With Wetlands Without Producing Greenhouse Gases

Principal Investigator: Joseph Yavitt

The Need

Since 1900, New York state has lost 60% of its wetlands as land was cleared for agriculture. Wetlands help improve water quality, store carbon, prevent soil erosion and provide habitat for many species. Cleared wetlands quickly lose agricultural productivity, as soils erode away. When farmland is abandoned and unmanaged, it can become cattail marshes, which are far less beneficial than forested wetlands. Wetland restoration, while beneficial for many reasons, can also lead to increased production of greenhouse gases like methane and nitrous oxide: As re-emerging wetlands trap more organic materials, the microorganisms that thrive in wet soils consume those materials and release more climate-disrupting greenhouse gases.

The Approach

This project sought to better understand the role of alder trees in restoring wetlands while mitigating greenhouse gas emissions. Alder trees work symbiotically with soil bacteria: The bacteria pull nitrogen from the atmosphere and make it available to the trees, and the trees give back sugar to the bacteria, benefiting both partners. The researchers took soil samples at the site of a wetland restoration project near Ithaca, New York, that includes abandoned agricultural land and is located near active crop cultivation and animal agriculture. They sampled three areas: an undisturbed wetland, a previously farmed returning wetland and a present-day farm. After analyzing those soil samples, the researchers mimicked soil microbial interactions in laboratory studies to understand how soil microorganism activity and growth rates react in the presence of alder trees, other plants that can use atmospheric nitrogen (“nitrogen-fixing plants”) and plants that don’t use that type of nitrogen as effectively.

The Impacts

Soil carbon storage in the undisturbed wetland site was much higher (>7.3%) than at either of the other sites. Soil carbon levels in the returning wetland were only comparable to levels at the active farm: 3.5% and 3.4%, respectively. Alder trees do help mitigate greenhouse gas emissions as wetlands recover; even though the soil microorganisms were producing more nitrogen, the trees were taking it up before it could be released into the atmosphere. Wetlands reforestation with nitrogen-fixing plants like alder trees also aids soil recovery, but slowly: The researchers project that restored wetlands at the site will need 26-32 years of tree growth to recover to 90% of their original capacity.