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The Dynamics and Significance of Carbon Monoxide Exchanges Between Wetlands and the Atmosphere

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Organization: University of Maine

The Dynamics and Significance of Carbon Monoxide Exchanges Between Wetlands and the Atmosphere

Project Participants

Senior Personnel

Name: King, Gary
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Name: Rich, Jeremy
Worked for more than 160 Hours: Yes
Contribution to Project:
Completed M.S. degree

Undergraduate Student

Name: Rollins, Jarod
Worked for more than 160 Hours: Yes
Contribution to Project:
Summer REU student

Name: Garey, Meredith
Worked for more than 160 Hours: Yes
Contribution to Project:
Summer REU student

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Project Activities and Findings:
The major research activities for this project involved an assessment of carbon monoxide fluxes from a wetland in Maine, an assessment of the role of illumination (ultraviolet and PAR) on CO fluxes, and an analysis of the microbiology of carbon monoxide utilization under oxic conditions in wetland peats and on plant root tissues.

The major educational activities included supervision of a Masters student who completed a degree in Microbiology, and supervision of two summer REU interns, one of whom used results from summer research for an Honor's thesis at Mt. Holyoke College and for presentations at national meetings.

Project Training and Development:

Primary results of the study indicated that wetland emissions of carbon monoxide to the atmosphere are relatively low and almost exclusively determined by the effect of illumination on CO production from aboveground plant biomass. Although porewater and plant stem CO concentrations exceed those expected for equilibrium with the atmosphere, belowground sources of CO appear minimal. Temperature has little impact per se on CO emissions with ultraviolet radiation a key factor. Radiation at wavelengths > 400 nm is also an important factor in CO emissions. In marked contrast, methane emissions depended on temperature, were insensitive to light conditions and occurred at substantially higher rates.

Microbiological and biogeochemical assays indicate that aerobic CO-oxidizing bacteria inhabit plant roots and surface peats. In the presence of oxygen, these microbes appear to limit fluxes of CO from belowground to the atmosphere. Oxygen availability is the key factor limiting CO oxidation. An effort to enrich and isolate CO oxidizers resulted in the discovery of a novel CO oxidizer belonging to the genus, Xanthobacter, a group previously unknown as CO oxidizers.

Research Training:
The project provided both Masters and REU students with a variety of skills. These included use of gas chromatography for trace gas assay, use of enrichment and isolation methods for novel microbes, use of physiological and biochemical tools for assaying microbial activity, use of molecular tools for identifying microbes, use of field approaches for assessing trace gas fluxes in sit. In addition, all students associated with the project gained experience in writing and presenting scientific results.

Outreach Activities:
Participated in a range of public school activities and presented seminars to the public.

Journal Publications

Rich, J.J. and G.M. King., "Carbon monoxide oxidation by bacteria associated with the roots of freshwater macrophytes.", *Appl. Environ. Microbiol.*, p. 4939, vol. 64, (1998).) Published
Rich, J.J. and G.M. King., "Aerobic and anaerobic transformations of carbon monoxide in freshwater peats.", *FEMS Microbiol. Ecol.*, p. 215, vol. 28, (1999).) Published
King, G.M., "Characteristics and significance of atmospheric carbon monoxide consumption by soils.", *Chemosphere: Global Change Sci.*, p. 53, vol. 1, (1999).) Published
King, G.M. and M.A. Garey., "Ferric iron reduction by bacteria associated with the roots of freshwater and marine macrophytes.", *Appl. Environ. Microbiol.*, p. 4393, vol. 65, (1999).) Published

Books or Other One-time Publications

T. Fenchel, G.M. King, T.H. Blackburn , "Bacterial biogeochemistry: the ecophysiology of elemental cycles ", (1998). *Book*, Published
Bibliography: Academic Press, New York

Web/Internet Sites

URL(s):

Description:

Other Specific Products

Contributions

Contributions within Discipline:
Contributions included the first assessment of wetland CO fluxes in situ on a seasonal basis. The results help in developing complete models of the role of wetlands in global change. In addition, we have obtained a novel CO-oxidizing bacterium, which helps further the understanding of microbial utilization of CO.
Contributions to Other Disciplines:

Contributions to Human Resource Development:
The project contributed to the career development of a student currently enrolled in a Ph.D. program and to the undergraduate education of two students, at least one of whom will pursue further graduate level training in science.
Contributions to Science and Technology Infrastructure:

Beyond Science and Engineering:

Categories for which nothing is reported:

Organizational Partners
Any Product
Contributions: To Any Other Disciplines
Contributions: To Any Science or Technology Infrastructure
Contributions: Beyond Science or Engineering