

UC San Diego

Research Summaries

Title

Controls on the Net Carbon Emissions from Restored Wetland Ecosystems

Permalink

<https://escholarship.org/uc/item/7gr0r84j>

Author

McNicol, Gavin

Publication Date

2014-10-24



Controls on the Net Carbon Emissions from Restored Wetland Ecosystems

Gavin McNicol, Delta Science Fellow

BACKGROUND

Over millennia, wetlands in river deltas have built up deep reserves of organic matter, but widespread draining in the past century has led to a rapid loss of carbon from wetland peat soils in the form of carbon dioxide (CO₂).

In the Delta alone, exposed peat soils account for approximately 1 percent of California's overall carbon dioxide emissions.

Restored wetlands can return to serving as a CO₂ sink, yet initial research suggests they may have potential to release enough methane (CH₄), a more powerful greenhouse

gas, to offset the benefit of CO₂ sequestration. However, very little is understood about which wetland traits influence CH₄ cycles. A better understanding of CH₄ and CO₂ cycling in restored wetlands would be of significant value to both restoration planning and climate models.

PROJECT

The Fellow is investigating the relative importance of release pathways, soil type and plant-microbial interactions on methane flux (cycles) in two restored Delta wetlands. The Fellow is comparing CH₄ emissions from each of three possible pathways – diffusion through the water column, ebullition (bubbling), and plant-mediated transport – using a series of floating chambers and dissolved gas measurements to quantify CH₄ fluxes in open water, as well as sampling of emergent vegetation. Future work will examine how temperature and carbon additions influence the carbon sources for wetland CH₄ production.

The end goal is to understand fine-scale carbon exchange patterns within a wetland and how they vary based on emergent plants, soil type and over time.



A large amount of McNicol's research was conducted at a study site on Sherman Island, left. *IMAGE: CA Dept. Water Resources*

The newly restored wetland on Sherman Island near Mayberry Slough, below, was flooded in late 2010 and contains patches of emergent vegetation interspersed within open water. *PHOTO: G. McNicol*

The older wetland on Twitchell Island, below right, was flooded in 1997 and has high plant cover. *PHOTO: G. McNicol*



PROGRESS

Ebullition sampling began in summer 2013 and will continue through February 2015. Preliminary measures suggest the studied wetlands release approximately 10-20L gas per square meter per year (approximately 10 percent of wetland methane release), with spatial and season variation. Although ebullition remains roughly constant all year, results show a higher concentration of methane in bubbles released during summer months.

Additionally, radiocarbon dating reveals the carbon released is 600-2200 years old, indicating a substantial amount

of young, surface carbon was lost from the wetlands prior to restoration and that the remaining peat may have different traits. Since carbon fixed by restored vegetation is much younger, the Fellow has been able to observe spatial and seasonal patterns in the age of methane, suggesting that the source of carbon varies.

The Fellow hopes to develop a hypothesis for what drives variation in methane concentration and age during ebullition.

MANAGEMENT APPLICATIONS

Results will provide assistance in developing restored wetland designs that quantify and minimize methane emissions by taking into account the role of emergent plants, open water and seasonal water levels.

PRESENTATIONS & POSTERS

McNicol, G. (2014) Quantifying greenhouse gas (CO_2 , CH_4 , N_2O) release via ebullition in restored Delta wetlands, Oral, 8th Bay-Delta Science Conference, Sacramento, Calif.

McNicol, G. (2014) A radiocarbon (C_{14}) approach to distinguish carbon sources of wetland methane production. (Poster) Annual Livermore Post-doc Symposium, Lawrence Livermore National Laboratory, Livermore, Calif.

McNicol, G. (2013) Maximizing the climate change mitigation potential of carbon farming: Controls on methane fluxes in wetlands of the Sacramento-San Joaquin Delta. (Poster) 11th Biennial State of the San Francisco Estuary Conference, Oakland, Calif.

“ Though wetlands are typically sinks of CO_2 , they are also the largest natural source of methane, a potent greenhouse gas.”

-Gavin McNicol, Delta Science Fellow

RESEARCH MENTOR

Whendee Silver, Department of Environmental Science, Policy and Management, UC Berkeley

COMMUNITY MENTOR

Belinda Morris, California Director, American Carbon Registry



CONTACT

Gavin McNicol
Graduate Student
UC Berkeley
510-643-3963
gavinmcnicol@berkeley.edu



DELTA STEWARDSHIP COUNCIL



This publication is sponsored by a grant from the Delta Science Program, part of the Delta Stewardship Council, and is based on research findings from project R/SF-57. The views expressed herein are those of the authors and do not necessarily reflect the views of the Delta Stewardship Council or any of its sub-programs. This document is available in PDF on the California Sea Grant website: www.csgc.ucsd.edu. California Sea Grant, Scripps Institution of Oceanography, University of California, San Diego, 9500 Gilman Drive, Dept. 0232, La Jolla, CA 92093-0232
Phone: 858-534-4440; Email: casgcomms@ucsd.edu / Printed 2014