Sea Grant California

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 (CO_2).

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 CO_2 sink, yet initial research suggests they may have potential to release enough methane (CH_4), a more powerful greenhouse gas, to offset the benefit of CO_2 sequestration. However, very little is understood about which wetland traits influence CH_4 cycles. A better understanding of CH_4 and CO_2 cycling in restored wetlands would be of significant value to both restoration planning and climate models.

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*

PROJECT

The Fellow is investigating the relative importance of release pathways, soil type and plant-microbioal interactions on methane flux (cycles) in two restored Delta wetlands. The Fellow is comparing CH_4 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 CH_4 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 CH_4 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.

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

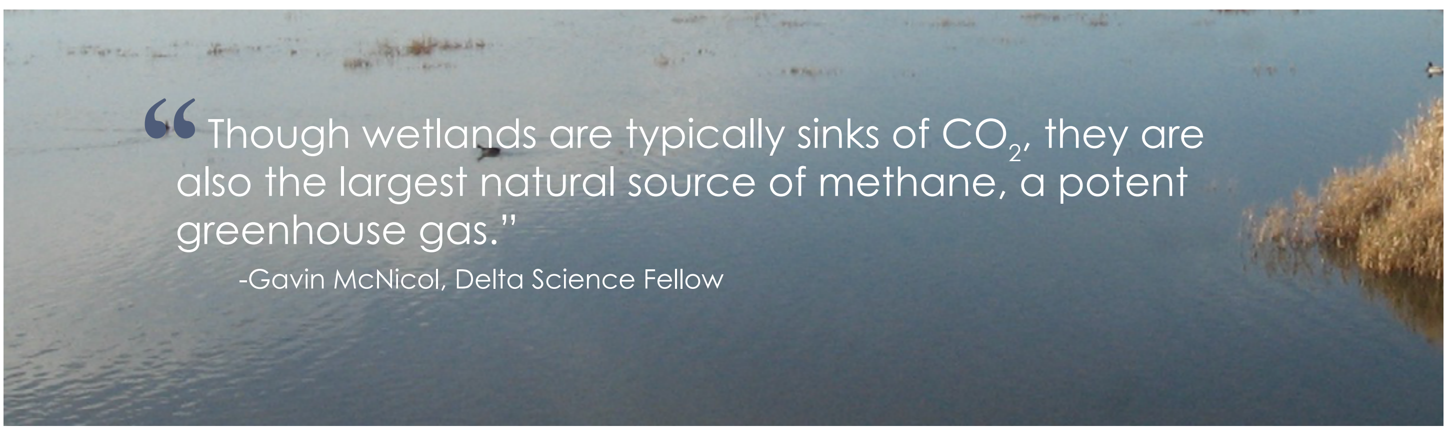
Results will provide assistance in developing restored wetland designs that quantify and minimize methane emissions by taking into account the role of emergent plants, open water and seasonal water levels.

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.



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