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# Relationship between methane flux and carbon uptake in three cosmopolitan wetland plant genera

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## Abstract

Wetlands are the most important natural source of methane (CH<sub>4</sub>) to the atmosphere. When present, plant efflux is often the dominant pathway for methane emissions from the anoxic wetland sediments, however, they are rarely considered in chamber measurement campaigns of CH<sub>4</sub> flux in wetlands. While studies have focused on the mechanisms that govern transport through plant structures, none have addressed how CH<sub>4</sub> emissions relate with carbon uptake or how this relationship may vary among plants. Understanding this relationship has important implications for linking carbon flux at the ecosystem level to wetland CH<sub>4</sub> emission predictions, and ultimately, to help improve current carbon budget and greenhouse gas models of wetlands. This study presents simultaneous measurements of CH<sub>4</sub> and CO<sub>2</sub> fluxes in three macrophyte species of different cosmopolitan genera: *Typha* (emergent), *Nelumbo*, and *Nymphaea* (floating attached). These measurements were conducted using the Picarro GasScouter G4301 fitted with custom-designed leaf chambers. Chamber measurements were performed three times during a day (morning, noon and afternoon), in three separate months. Results indicate significant negative correlations between CH<sub>4</sub> flux and carbon uptake in *Nelumbo* and *Nymphaea* species and a non-significant positive correlation in *Typha* sp. We term the rate of CH<sub>4</sub> flux per unit CO<sub>2</sub> uptake – CH<sub>4</sub> flux efficiency. We found that in *Nymphaea* CH<sub>4</sub> flux efficiency is almost double that of *Nelumbo*. These results suggest the dependence of CH<sub>4</sub> efflux in stomatal conductance in the floating attached macrophytes, while in the *Typha* CH<sub>4</sub> flux is primarily through other pores, probably aerenchyma, not regulated by stomata. Our results emphasize the importance of species-specific knowledge and considering the growth type of different wetland macrophytes (e.g. emergent vs floating attached) in scaling of bottom-up observations and ecosystem models.



# Relationship between methane flux and carbon uptake in three cosmopolitan wetland plant genera

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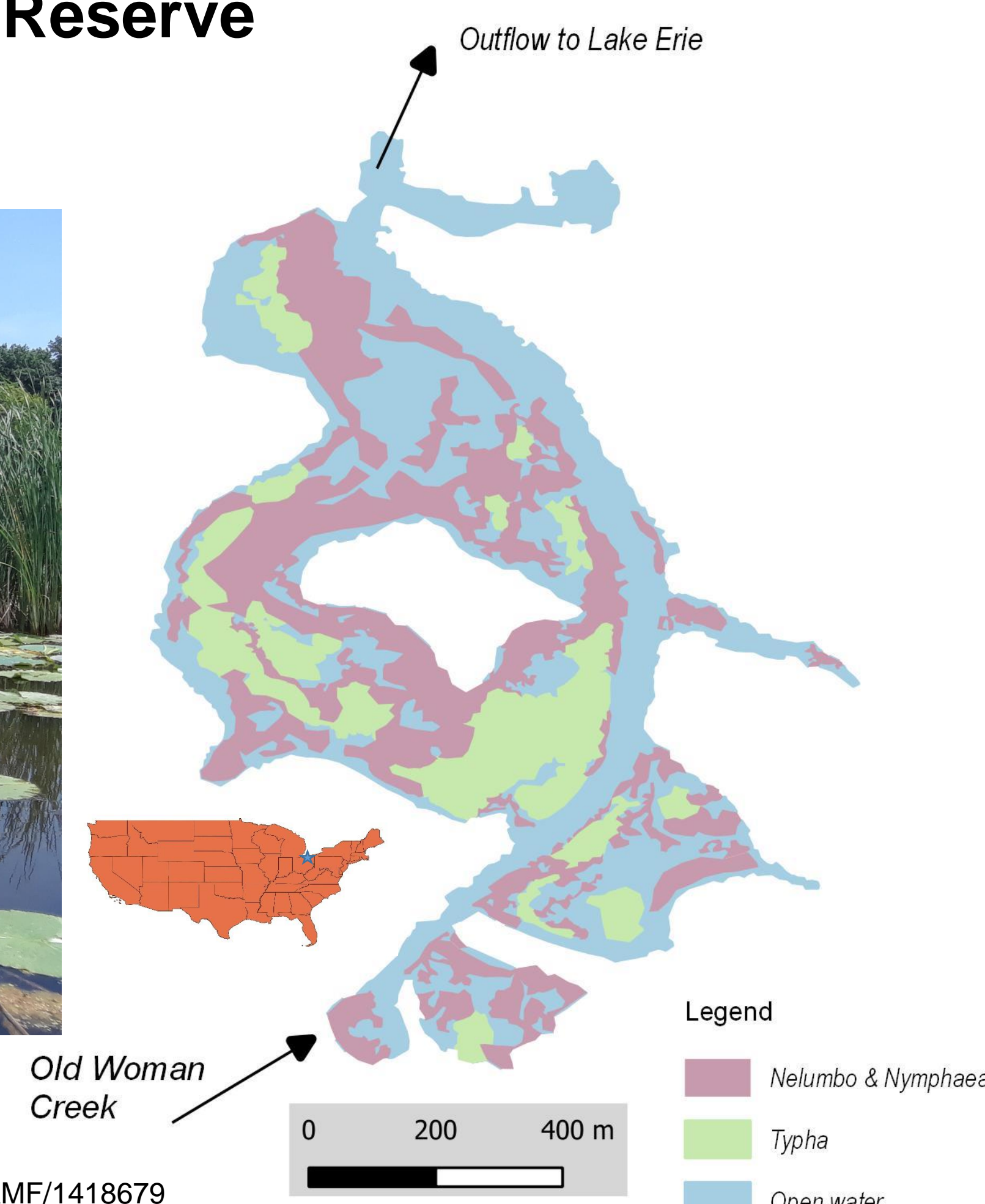
<sup>2</sup> Department of Chemical, Biochemical and Environmental Engineering. University of Maryland, Baltimore County

## ABSTRACT

Wetlands are the most important natural source of methane ( $\text{CH}_4$ ) to the atmosphere. When present, plant efflux is often the dominant pathway for methane emissions from the anoxic wetland sediments, however, they are rarely considered in chamber measurement campaigns of  $\text{CH}_4$  flux in wetlands. While studies have focused on the mechanisms that govern transport through plant structures, none have addressed how  $\text{CH}_4$  emissions relate with carbon uptake or how this relationship may vary among plants. Understanding this relationship has important implications for linking carbon flux at the ecosystem level to wetland  $\text{CH}_4$  emission predictions, and ultimately, to help improve current carbon budget and greenhouse gas models of wetlands. This study presents simultaneous measurements of  $\text{CH}_4$  and  $\text{CO}_2$  fluxes in three macrophyte species of different cosmopolitan genera: *Typha* (emergent), *Nelumbo*, and *Nymphaea* (floating attached). These measurements were conducted using the Picarro GasScouter G4301 fitted with custom-designed leaf chambers. Chamber measurements were performed three times during a day (morning, noon and afternoon), in three separate months. Results indicate significant negative correlations between  $\text{CH}_4$  flux and carbon uptake in *Nelumbo* and *Nymphaea* species and a non-significant positive correlation in *Typha* sp. We term the rate of  $\text{CH}_4$  flux per unit  $\text{CO}_2$  uptake –  **$\text{CH}_4$  flux efficiency**. We found that in *Nymphaea*  $\text{CH}_4$  flux efficiency is almost double that of *Nelumbo*. These results suggest the dependence of  $\text{CH}_4$  efflux in stomatal conductance in the floating attached macrophytes, while in the *Typha*  $\text{CH}_4$  flux is primarily through other pores, probably aerenchyma, not regulated by stomata. Our results emphasize the importance of species-specific knowledge and considering the growth type of different wetland macrophytes (e.g. emergent vs floating attached) in scaling of bottom-up observations and ecosystem models.

## STUDY SITE

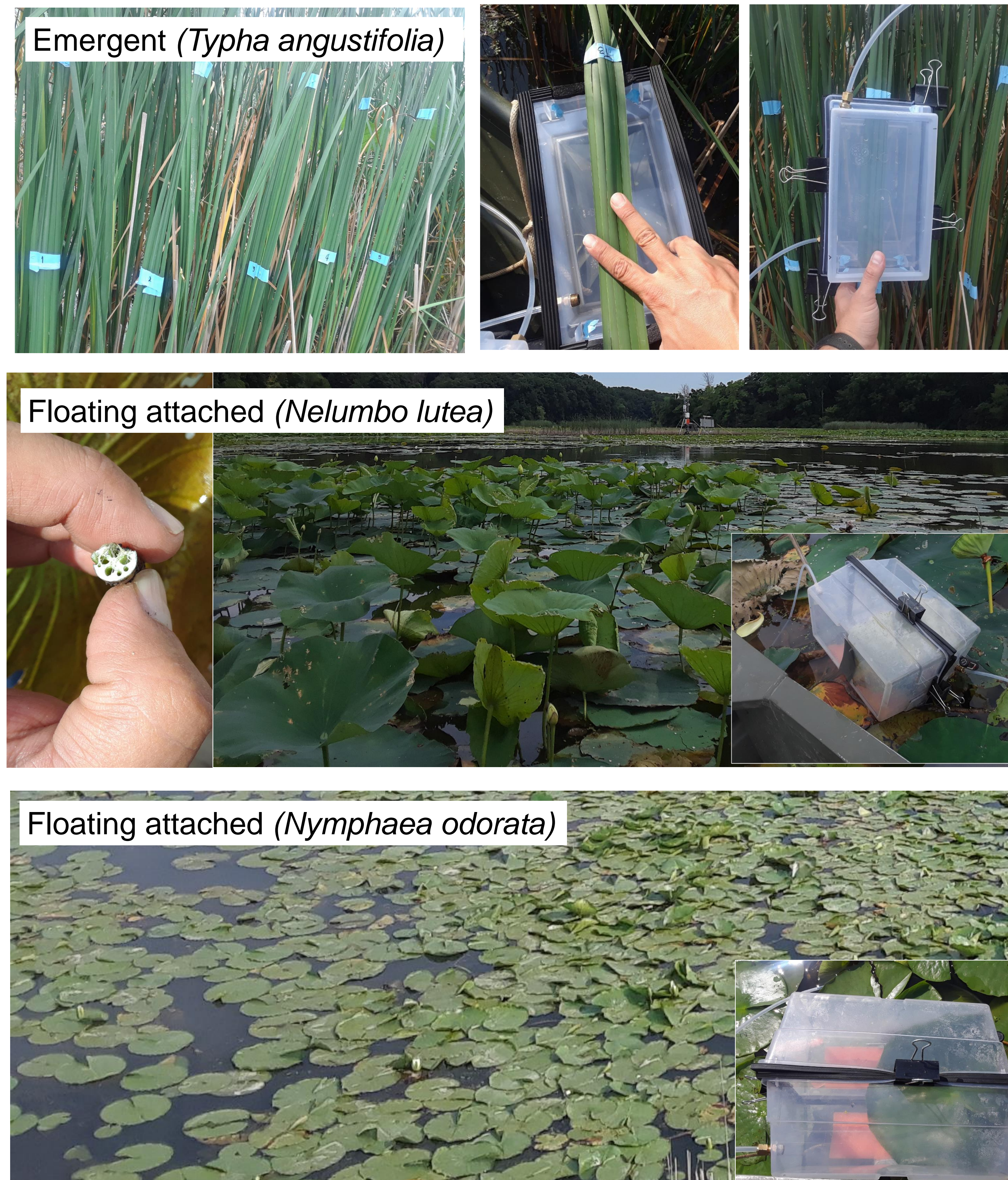
### Old Woman Creek National Estuarine Research Reserve



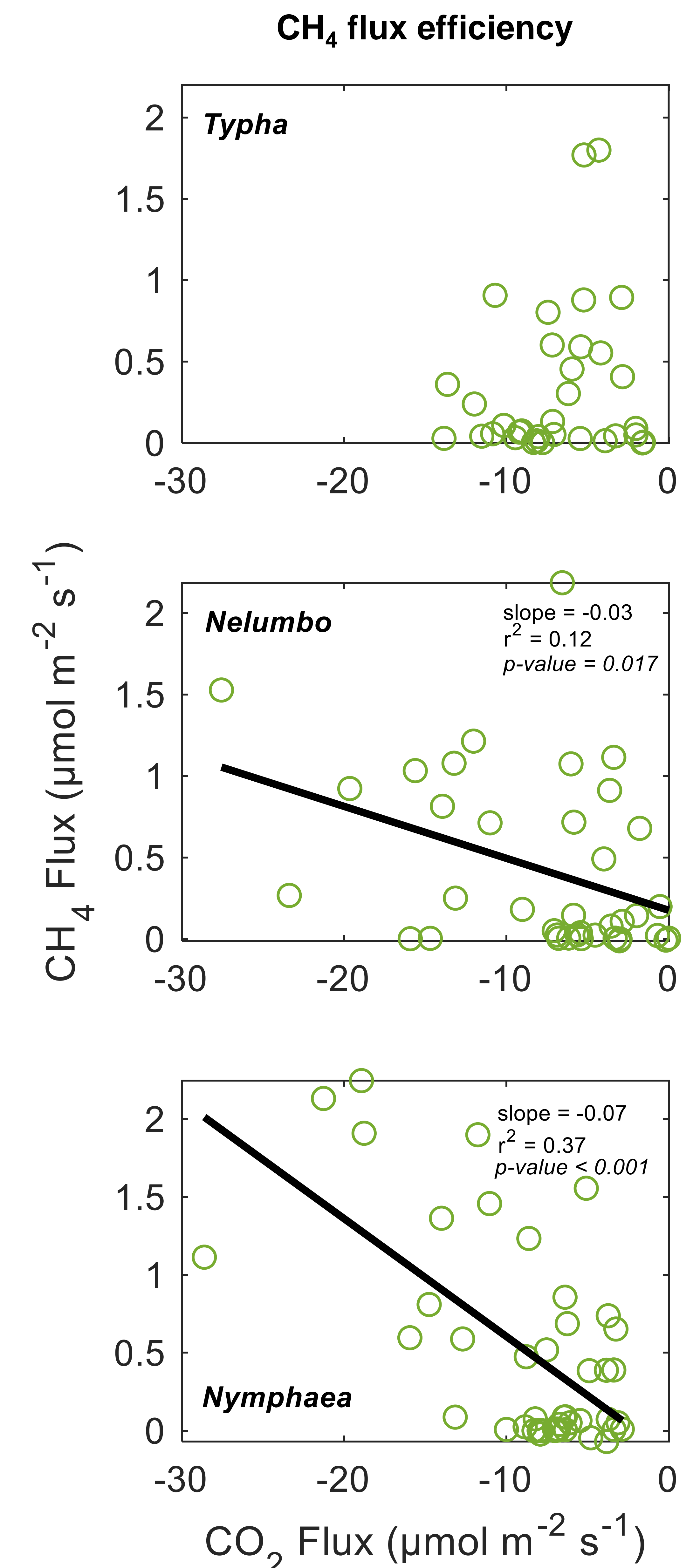
Site data at:  
AmeriFlux US-OWC Old Woman Creek, doi:10.17190/AMF/1418679  
<http://coastal.ohiodnr.gov/oldwomancreek>

ACKNOWLEDGEMENTS: Ohio Water Development Authority (project 7880)  
OWC site access and technical support: Kristin Arend (NERR/NOAA/ODNR)

## THREE PLANT SPECIES



## TRANSPORT PATHWAY CONTROL $\text{CO}_2$ RELATIONS



## $\text{CH}_4$ EFFLUX THROUGH PLANTS

