Rising CO_2 and N influence *Phragmites australis* functional traits and carbon fixation

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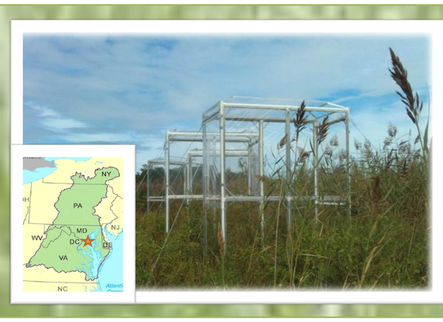
Introduction

An invasive Eurasian lineage of the common reed, *Phragmites australis*, is known to have plastic responses to predicted future conditions of atmospheric CO_2 and soil N pollution (Mozdzer and Megonigal 2012). In greenhouse conditions, elevated CO_2 increased *Phragmites* growth both above and belowground, suggesting it may be a better competitor in field conditions. We determined functional trait responses of *Phragmites australis* from a factorial CO_2 × N field experiment to evaluate the effects of global change factors on canopy structure and carbon fixation. We addressed the following questions:

- **How does elevated CO_2 and N pollution affect *Phragmites* functional traits?**
- **How do global change factors influence plant functional traits affecting carbon fixation?**

Figure 1: CO_2 x N *Phragmites* chambers with inset of location of SERC.



12 Open top chambers (n = 3 per treatment)

- **Ambient CO_2**
- **Elevated CO_2 (+300 ppm)**
- **+N (+25 g N m^{-2} y^{-1})**
- **Elevated CO_2 +N**

Methodology

Leaf area: 9 per treatment

Internode length: 10 plants *in situ*

Vertical growth rate: 15 per chamber

Relative Length Growth Rate (RLGR) modeled as logistic growth (Clevering et al. 2001)

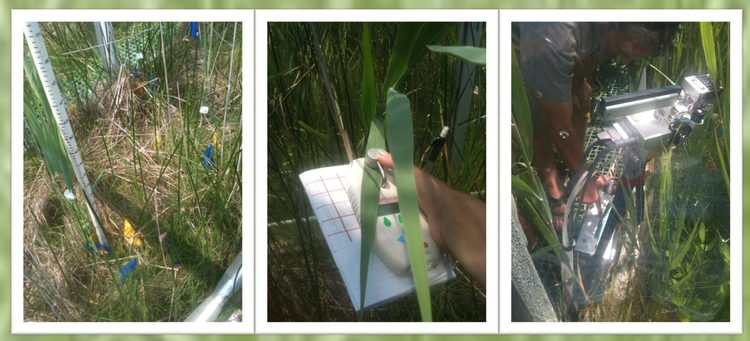
Canopy structure: 5 cm layers of leaf area and position

Leaf senescence: Tracked in 9 plants per treatment

Photosynthetic rates: Monthly 9 per treatment

Relative chlorophyll index: 15 per chamber

Measurement of vertical growth rate	Measurement of relative chlorophyll index	Measurement of photosynthetic rates



Plants grow taller with N

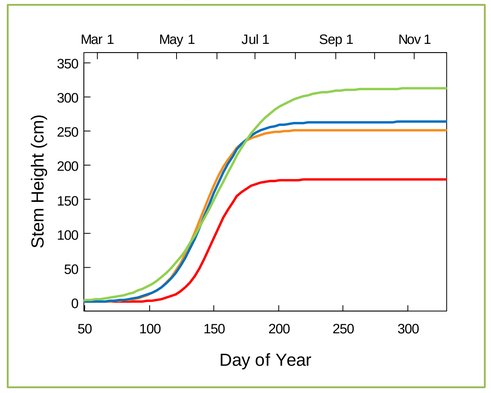


Figure 2: Stem elongation (RLGR) modeled from representative plants by treatment.

Chlorophyll index increases with N

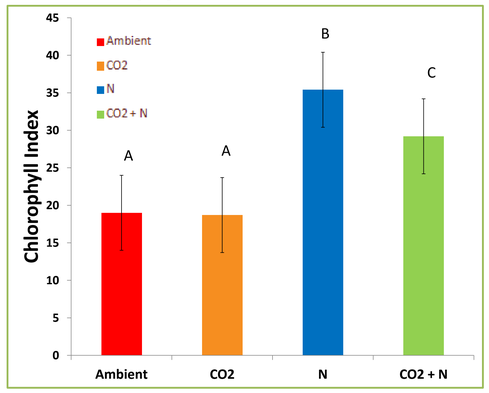


Figure 3: Mean relative chlorophyll index by treatment (error bars are ± 1 standard deviation).

Leaf area increases with N

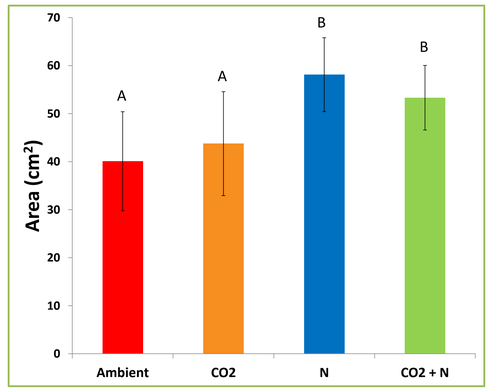


Figure 4: Mean individual leaf area by treatment (error bars are ± 1 standard deviation).

Photosynthetic rates increase with CO_2 and N

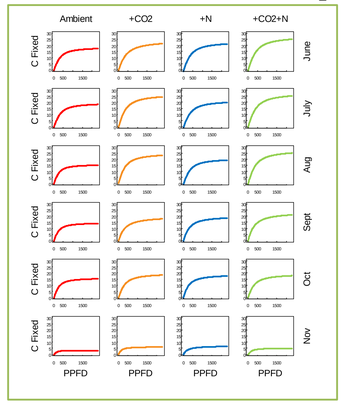


Figure 5: Light response curves by treatment. Note the maximum photosynthetic rates.

Amount of carbon fixed increases with CO_2 and N

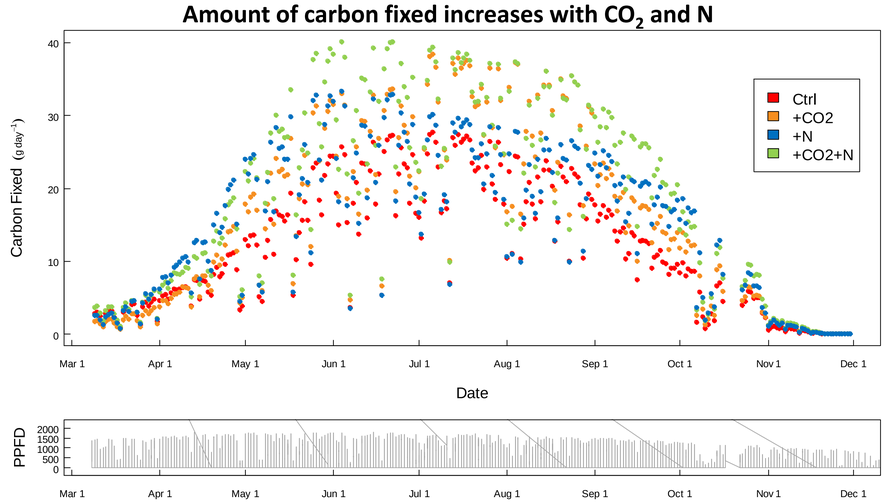


Figure 6: Amount of carbon fixed per day, per m^2 of monotypic *Phragmites*. Modeled using data described in Methodology, along with PPFD (light) time series data at the SERC dock.

Results & Conclusion

	Mass C fixed	% difference
Ambient	3.1 kg	
+CO_2	4.2 kg	+34%
+N	4.2 kg	+31%
+CO_2 +N	4.9 kg	+56%

CO_2 Effects

- Increase photosynthetic rates (Figure 5)
- Increase Carbon fixed (Figure 6)

N Effects

- Increase height over growing season (Figure 2)
- Increase chlorophyll content (Figure 3)
- Increase leaf area (Figure 4)
- Increase Carbon fixed (Figure 6)

However, CO_2 and N are allocated differently

- N effects are largely aboveground (Langley et al., 2010)
- CO_2 effects are largely belowground (Iverson, 2010)

Therefore, these traits individually effect the carbon fixation ability of *Phragmites*. Yet both climate change factors will increase the competitive advantages of the invasive lineage of *Phragmites* over native species, further influencing its presence and domination.

Future Directions

Examine climate change influenced effects below ground

- Changes in rooting depth & associated biogeochemical feedbacks.

Effects on carbon cycle

- Linkage of CO_2 increases on methane emissions (Mozdzer and Megonigal, 2013) and carbon fixation.

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