Wetland clonal herbaceous plants explore their space through clonal reproduction, parent ramets creating daughter ramets interconnected underground and able to share nutrient resources. Historically limited by low nutrient conditions, coastal wetlands have seen an influx of nutrients. Limitations removed, wetlands have experienced greater threat from nonnative species. The ability of a native species to branch – a parent ramet creating two daughter ramets – and the resulting underground architecture may have great effect on the biotic resistance of these native communities because spatial exploration is an important facet of plant competition. The goals of this project were to create visualization software to examine the architecture of a simulated wetland created by MONDRIAN, and answer the question: if a manager has a choice of species to plant the year after herbicide treatment, would a species with a higher branching rate – all else equal – make it more likely to keep an invader at bay?

**Wetland Clonal Architecture**

Clonal branching permits exploration of the environment and leads to greater nutrient richness in areas it has already colonized, thereby becoming established quicker and better able to resist the invasive P. australis.

**MONDRIAN and Model Setup**

MONDRIAN – Modes Of Nonlinear Dynamics, Resource Interactions, And Nutrient cycling – is a clonal herbaceous wetland simulator developed by Dr. William Currie and others (Currie et al. 2014). I have used MONDRIAN to examine native coastal wetland biotic resistance based on clonal branching architecture. The model was run with nine different inputs, each with three stochastic runs averaged for the final numeric results evaluated. The model was run with three different natives: Eleocharis smallii, Juncus balticus, and Schoenoplectus acutus. Each native competed alone against the invader: Phragmites australis. Each native ran with three branching probabilities: 10%, 17%, and 24%. The invader’s branching probability was kept constant at 17%. The nutrient loading conditions for the smallii have used MONDRIAN to examine native coastal wetland biotic resistance based on clonal branching probability accounting for less than 25% NPP. E. smallii is the smallest native species with the shortest inter-ramet distance, and increased branching may result in ineffective exploration of space. Alternatively, the larger native species, J. balticus and S. acutus, respond positively to increased branching probability. This may result from the larger inter-ramet distance allowing them to naturally explore space well, and increased branching rates better their ability to dominate an area quickly, therefore blocking P. australis from establishing in these areas.

**MONDRIAN Key Terms**

- Biotic resistance: The ability of a native wetland plant community to resist invasion by a nonnative species
- Ramet: A physiologically distinct organism that is part of a group of genetically identical individuals derived from one progenitor
- Terminal branching: A parent ramet that has not yet reproduced creating two daughter ramets
- Lateral branching: A parent ramet that has already reproduced creating another daughter ramet
- Inter-ramet distance: Distance between parent ramet and daughter ramet
- Branching probability: After the parent ramet passes every qualification to produce a daughter ramet
- Limitations removed, wetlands have experienced greater threat from nonnative species. The ability of a native species to branch – a parent ramet creating two daughter ramets – and the resulting underground architecture may have great effect on the biotic resistance of these native communities because spatial exploration is an important facet of plant competition. The goals of this project were to create visualization software to examine the architecture of a simulated wetland created by MONDRIAN, and answer the question: if a manager has a choice of species to plant the year after herbicide treatment, would a species with a higher branching rate – all else equal – make it more likely to keep an invader at bay?

**Clonal Branching Effects on Biotic Resistance in Coastal Wetlands**

Clonal branching shows the branching benefit of quickly capitalizing on already colonized areas. This may result from the larger inter-ramet distance allowing them to naturally explore space well, and increased branching rates better their ability to dominate an area quickly, therefore blocking P. australis from establishing in these areas.

**Clonal Branching Effects on Biotic Resistance in Coastal Wetlands**

The visualization of 24% S. acutus branching shows the branching benefit of quickly capitalizing on nutrient richness in areas it has already colonized, thereby becoming established quicker and better able to resist the invasive P. australis.

**Conclusion**

The visualization of 10% S. acutus branching shows relative sparseness directly after the herbicide treatment, leaving some space available for establishment of P. australis. Comparatively, the visualization of 24% S. acutus branching shows the branching benefit of quickly capitalizing on nutrient richness in areas it has already colonized, thereby becoming established quicker and better able to resist the invasive P. australis.

**References**


Martina, Jason & Currie, William & Goldberg, Deborah & Elgersma, KJ. (2016). Nitrogen loading leads to increased carbon acclimation in both invaded and uninvaded coastal wetlands. Ecosphere. 7. 10.1002/ecs2.1459.