Do fungal mutualists alter the invasibility of restored dune plant communities?

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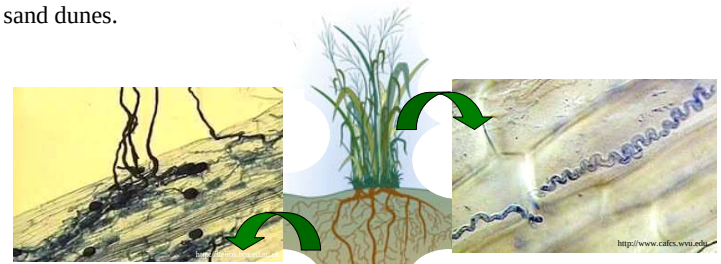
Introduction

Invasibility, in the broadest sense, describes the ease with which new species establish in a community, and so is fundamental to our understanding of succession as well as exotic species' invasions. Most studies of invasibility have focused on competition, predation, and disturbance. Recently though, it has been suggested that mutualisms may be equally important in community invasibility. With our research, we examine two common and widespread plant mutualists, arbuscular mycorrhizal fungi (AMF) and endophytic fungi (EF) to address the role of mutualisms for the invasibility of Great Lakes sand dunes.



Mycorrhizal fungi
-80% of angiosperms
-water and nutrient uptake
-diffuse mutualism
-known to increase diversity, invasion
(van der Heijden 2004)

Endophytic fungi
-20 to 30% of grasses
-herbivore resistance, nutrient uptake, drought resistance
-host specific
-can slow succession, reduce diversity
(Clay and Holah 1999, Rudgers et al. in prep)

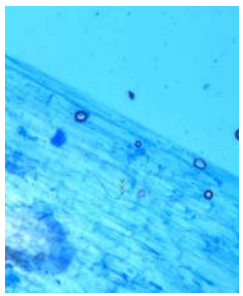
Great Lakes sand dunes provide an excellent system to examine the role of microbial mutualisms in regulating invasibility because:

Ammophila breviligulata

-plants establish from sterile soil conditions
-plants are in a high stress environment
-invasibility is critical to succession, but also means dunes are subject to invasive species
-there is a history of dune restorations (with possible altered fungi associations)
-the community is dominated by a native C3 grass, *Ammophila breviligulata*, which is reported to be infected by an endophyte in some East Coast systems

We expect EF to increase competitive dominance of *Ammophila*, thereby slowing invasion by other species. We expect AMF to increase invasion success of other species which are more AMF-dependent than *Ammophila*.

Methods and Preliminary Results



Endophyte hyphae in *Ammophila* leaf tissue

In a pilot study conducted in summer 2005, we surveyed *Ammophila* populations in six natural sites and one restored site for endophyte infection.

We also examined two common nursery varieties of *Ammophila* for endophyte infection, and found that the Cape variety was 100% infected with endophytes while the Vans variety (native MI genotypes) was 0% infected.

Table 1. EF infection rates in Michigan populations of *Ammophila breviligulata.*

Site/Population	Number of tillers infected
Grand Mere State Park, MI	0/10
Grand Mere Sand Mine, MI	5/15
Petoskey State Park, MI	0/6
Saugatuck State Park, MI	0/9
Van Buren State Park, MI	0/8
Warren Dunes State Park, MI	0/8
Wilderness State Park, MI	1/5
Cape Nursery Variety	14/14
Vans Nursery Variety	0/17

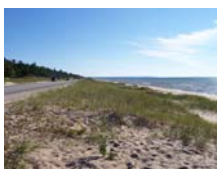
These results led us to the following questions:

1. Are AMF and EF more abundant in restored dunes than in natural dunes?

2.Are restored dunes more or less susceptible to exotic species invasion and native species colonization because of changes in these mutualists and their effects on the dominant species, Ammophila?

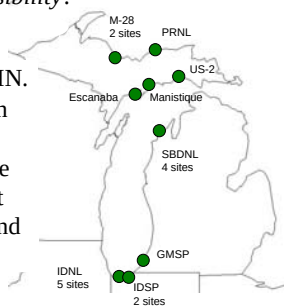
3. Do interactive effects of AMF and EF differ from their individual effects on community invasibility?

In summer 2006, we surveyed 18 paired restored and natural *Ammophila* populations in MI and IN.



Paired natural and restored sites along US-2 in MI

We measured EF infection levels, AMF diversity in the soil, plant community diversity, and insect diversity. Analyses are in progress. We will also be doing a series of greenhouse experiments to look at the effect of EF and AMF on *Ammophila* growth and competitive ability.



Future Directions

We are planning to start a restoration experiment in spring 2007, planting *Ammophila* with and without endophytes, and with and without added soil mycorrhizae. We will monitor natural invasion/ succession in these plots in subsequent years. We have one site at Sleeping Bear Dunes National Lakeshore but NEED ANOTHER SITE (preferably vegetation-free) as well. Contact me (Sarah.M.Emery@rice.edu) if you have any leads!!

AMF spores isolated from soil

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