1 Introduction

1.1 Relative timing of germination, species interactions, and climate change

1. The relative timing of germination is an important mechanism of species interactions; competition is often fiercest in early ontogony and chance of survival low.

2. Competitivive dominance and/or invasion success is often associated with rapid germination.

3. And this has been show to be mechaninsitic in experiments that staggered planting.

4. In most natural systems, the timing of germination is dicated by environmental cues rather than time of arival. Which means interannaul variation in envirnmental cues should correlate with interannual germination success.

5. If species have unique vital rate responses to their environment than 1) this can lead to coexistnace via the storage effect and 2) sustained alterations to environmental cues, ie, climate change has potetial to alter the relative timing of germination among species(hereafter: germination rank).

6. Depending on the strength differences among species (priority effects), cliamte change could amplify these differences and permantly alter community level germination ranks, shifting the balance of species' interactions, impacting demography and community processes.

1.2 Evidence for these dynamics

1. These dynamics have been show in annual desert and grassland systems where germination is primirly controlled by water availability. Give some examples. However it is unclear whether these seasonal priorty effects on germination matter in temperate forest systems.

1.3 Why temperate forests may be different

1. In temperate forest most species are perrenials (germination matters less for coexistance)

2. Physiological dormancy is common temperature (stratification and incubation) is the main driver of germination.

3. it is unclear the dfferences vital response rates to temperature are large enough to alter germination rank enough to impact priority effects/species interactions.

1.4 Our study

1. While assumptions of the storage effect need to be evaluated in temperate forests, we focus evaluating the extent to which species have unique vital rate responses to their spatial environment, and those differences may impact priorty effect. First, we performed a germination study to quantify unique vital rate responses to stratification and incubation temperatures for a suite of temperate herbaceous species to evlaute the potential for germination rank shifts with climate. The we extended to literture review of Young 2017 to evluate whether or not germination differences on this scale might influnce priority effect

Methods

Species

1. Mix of field and forest species because seed bank of forest is often old field
2. Mix of dormancy classes

1.5 Experimental Methods

1.6 Data anaylsis

I think we're going with the survival model. I'll just mention survial models assume everything germinations, which is a bad assumption so we decided anything that the t50 was greater than 30 days (or other) did not germination higher than that.

1.7 extension of literature review

1. search terms, how many studies in Young 2017
2. how many we added

Results

1. table 1: Matrix of species differences under cliamte change and reguar conditions
2. figure 1: mu plots, shape
3. plot of germination ranks under each scenario
4. Supp table of lit reivew with quantification of reponses (x out of y studies found priority effects with germination dfferences of ¡7 days, 7-21 days etc)

Discussion

- Yes, it seem like the differences are big enough to alter germination rank
- Next, we have to investigate if these differences drive performance differnces (priority effects)
- Our study didn't include risks to early germination–stabalizing selection on germiantion time.
- Germination may be less important in forest systems But germination may become more important as the need to migrate or distubrance regimes change.
- Population differences, maternial effects etc not accounted for.
- in forest germinations compete with ramets not just other seeds.
- These reulst should fit into larger deomography models that include survial, reproductive output etc.