

Introduction

1. Competition among plants is determined by a combination of intrinsic (growth rate, rooting depth, nutrient uses) and extrinsic (micro habitat, density dependence, founder effects) properties.
2. In temporally variable environments, climate variability mediates all these processes which allows for coexistence.
3. Climate change will effect these dynamics, and a major effort of community ecology in an era of global change is to anticipate how a changing environment will effect these species interactions.
4. There is evidence that competition in the early stages of plant ontogeny (“regeneration niche” might be particularly effected).
5. Observation in dry grasslands tell us that “storage effect dynamics” and “seasonal priority effects” are importan (?).
6. We also see that climate change might amplify the impotance of these processes.
7. However, we don’t know how important these temporal dynamics are in temperate forest species.
8. Several barriers:
 - (a) Unlike dryland where water avialability is the primary determinant of germination, in temperate forest there are 2 (stratification x incubation)

(b) Not alot of annuals. Which means:a) hard to measure fitness. b) hard to study seed emergence (is it a seed or a ramet?) c) competition between ramets may be historically more important but seeds matter for colonizing new areas and shifting do to climate change,

9. However we can understand the role of these dynamics by characterizing regeneration niches of species in contolled environemnts and applying them in current and future climate scenarios.

10. We do this.

Here's the points of the paper

1. We observed the response to a lot of different stratification regimes and 2 incubation temperatures for 3 temperate herbs as a case study and then modeled things in a bunch of different ways. We compare a day of change in stratification to a degree of change in warming and find that a the effect of one degree of warming is about 5x of 1 day of change (make plot or table of model results)....but....

2. Re-analyzing soil warming experiments we calculate how much stratification is supposed to change. Answer from Harvard Forest means 79.2 to 47.3 but sd's around 26. That's with just 2.5 degrees warming How does this impact species.?

3. Then we projected germination percentages under current and future climate scenarios based on the above measurements from Harvard Forest (Fig. 1). We see that the 5 degree incubation differences dont matter nearly as mich as the loss of stratification.

4. Because its not only aboslute germination % that affects competitions but also timoing of germination Also we used a survivial model to figure out when each species reach (Fig. 2). Here too, we see that stratification is the driver.

5. But Dan, these projections are just based on means. There is a ton of interannual variation in both scenarios. What about the storage effect? Couldn't that stabalize or eqlize dynamics?

If you simulate 100 years of variation under both scenarios, your figure from plot 1 looks quite different (Fig. 3).

6. Granted but let's think if it a different way. How often is germination incomplete in each scenario? Very different pictures (Fig. 4). This might make the storage effect way more important.

1 A TON of caveats

- we didn't actually measure competition just relying on the literature to say that propagule pressure and priority effects matter.
- Interannual variation might change with climate change too
- We aren't trying to say much about these specific species (we don't know about their seed banks, or competitive interactions, or the fact they compete with hundreds of others in the wild, or their seeds are often competing with vegetative propagations) but are using them to illustrate temporal dynamics could become more important with climate change as it highlights differences in the response of species to changing environments.
- this is especially prevalent in chilling. We assume chilling was usually met in the past for all species and will be met less often in the future.
- Overall, our study just shows we need to think about these dynamics in temperate forests. Do we really buy that?

2 Figures

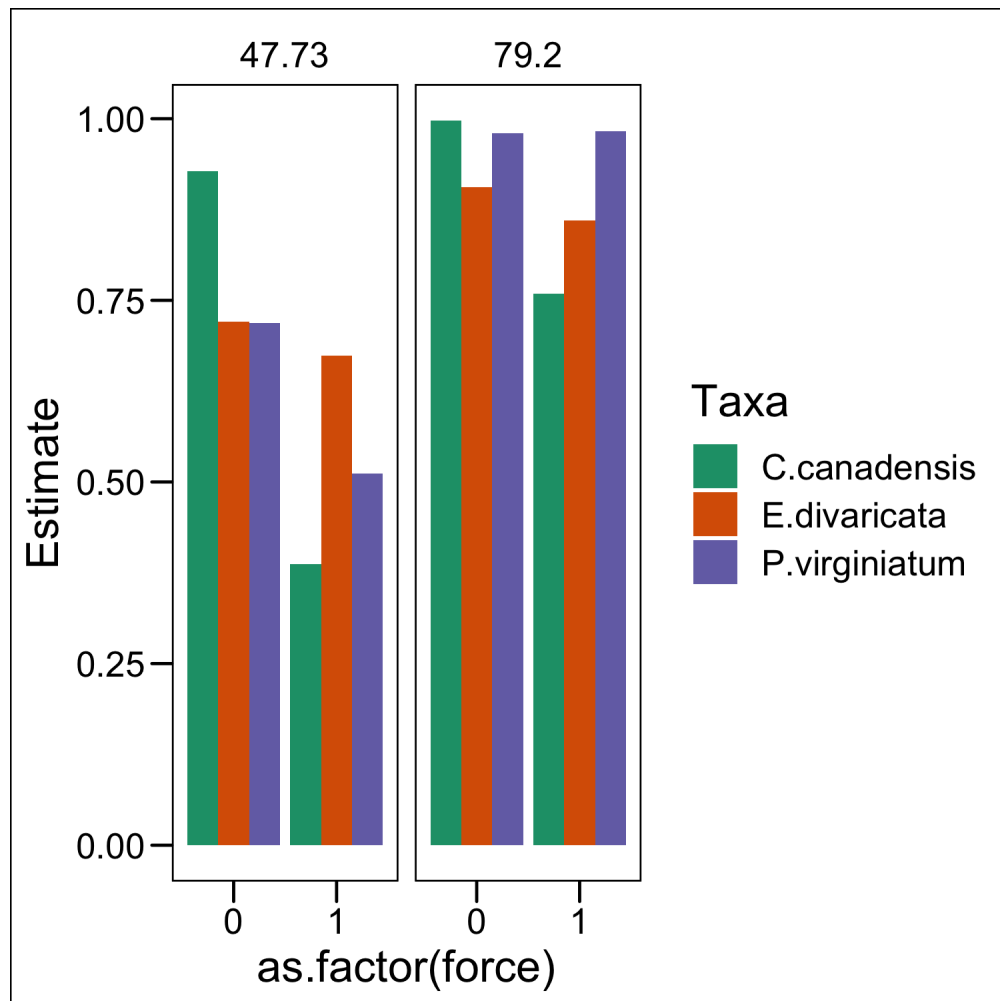


Figure 1: Under ambient conditions (79.2/0, all species germinat above 80%. This gets worse with warming, and way worse when chilling goes down and warming.

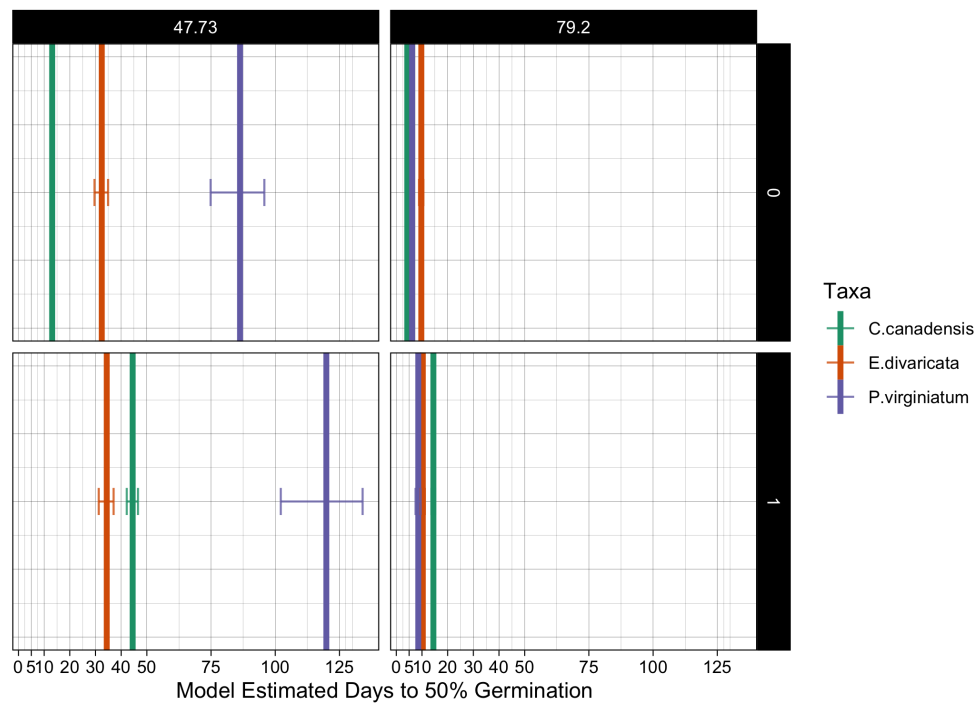


Figure 2: Look the timing of germination also gets spread amongst species with climate change, which likely will amplify priority effects

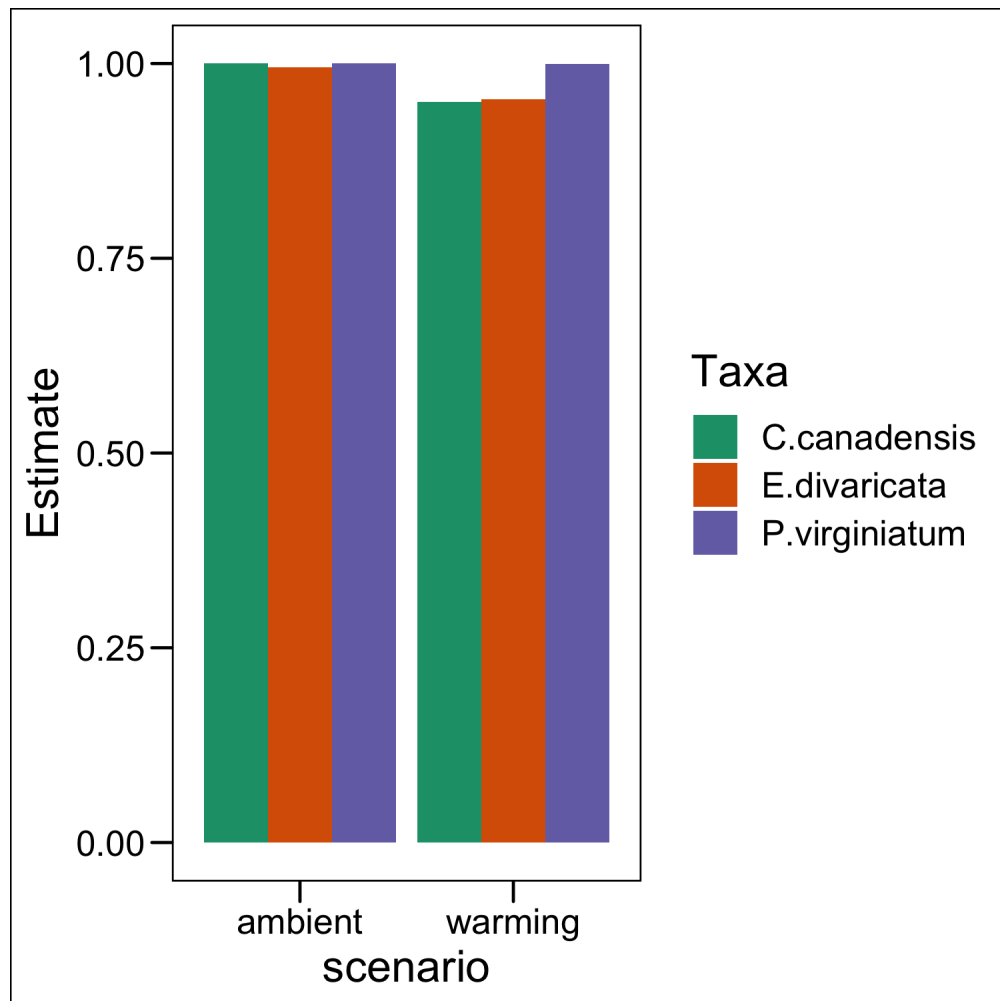


Figure 3: Over 100 year the mean germination percentages aren't that different if the variation stays similar

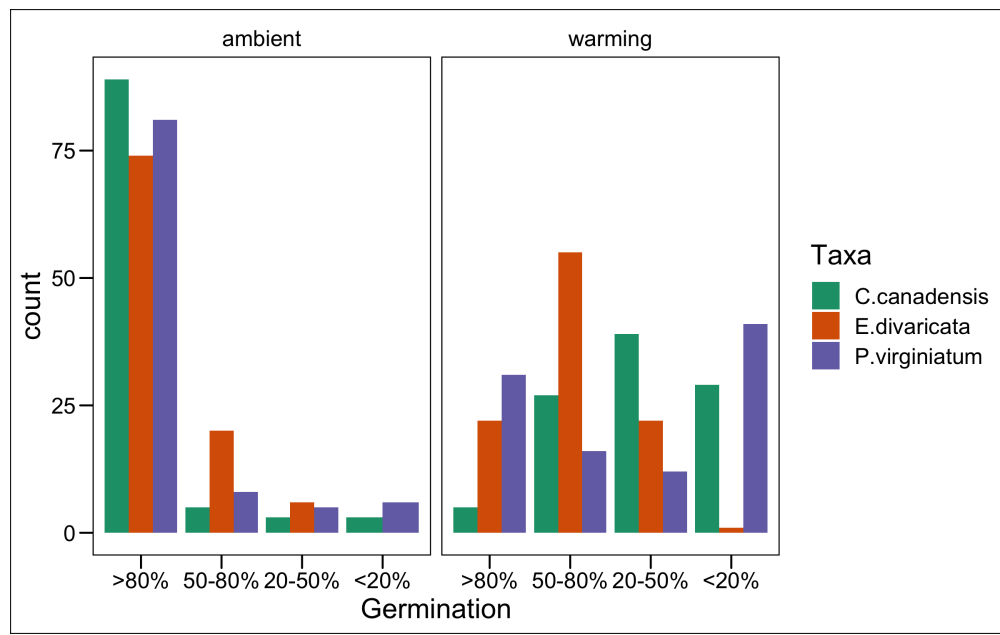


Figure 4: The years in which there is good germination go way down for all species, but different. If they seedbank this could make for some intense storage effect dynamics