Demographic buffering by context-dependent host-microbe interactions in stochastic environments

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Populations face increasing environmental variability under climate change. Context-dependent mutualisms may buffer hosts from demographic variance by reducing variability in population growth rates. The stochastic growth rate is the mean population growth rate over time in variable environments.

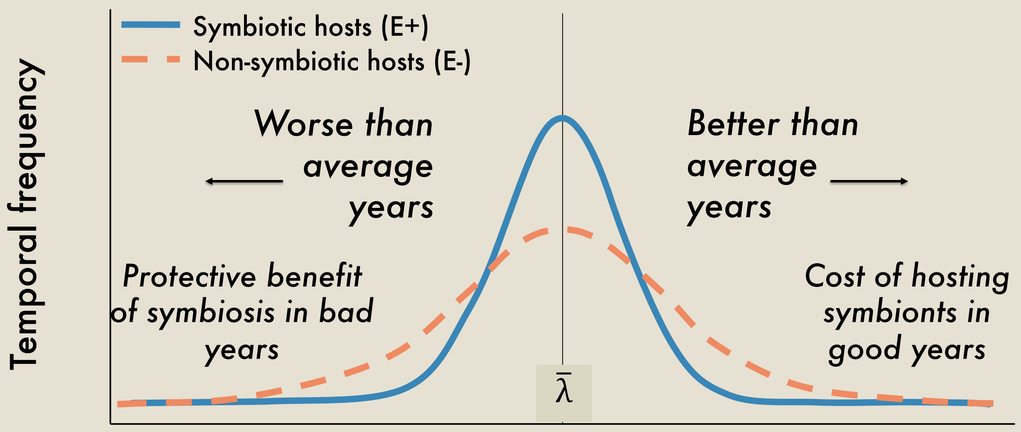
Stochastic Growth Rate | Average Growth Rate | Variance Penalty

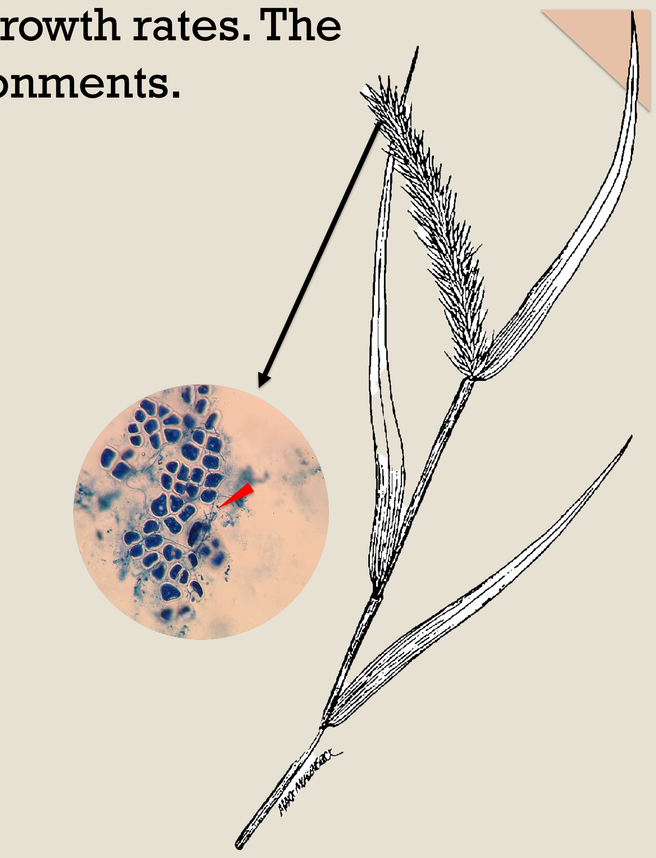
$$log(\lambda_S) \approx log(\bar{\lambda}) - \frac{\sigma^2}{2\bar{\lambda}^2}$$

We asked:

- Do fungal endophytes buffer demographic variance in their grass hosts?
- What is the relative importance of demographic buffering vs. mean effects in the overall fitness impact of the symbiosis?

Context-dependent interactions have the potential to limit the effects of very bad and very good years.



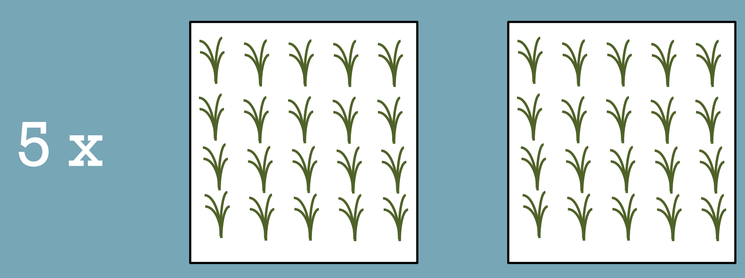


Epichloë fungi are common heritable symbionts of cool-season grasses that act as mutualists against herbivores and abiotic stresses. These effects can be context dependent: beneficial in some contexts but costly in others. Endophytes can be seen in seeds, stained in between the aleurone cells, as pictured here in *Elymus virginicus*.

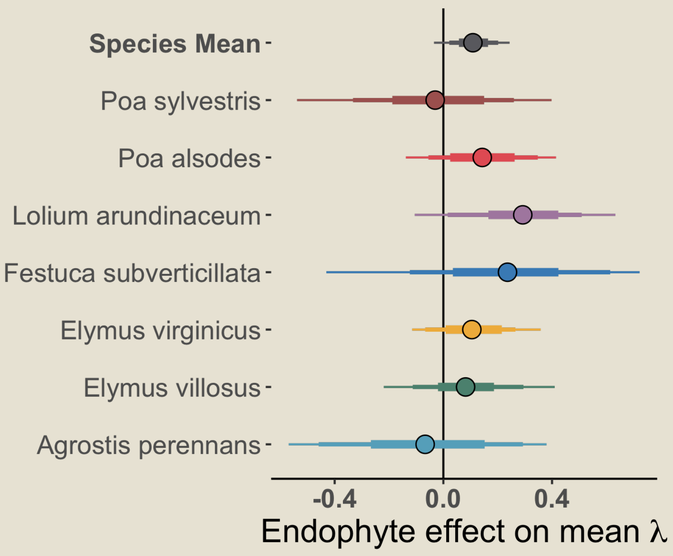
Using demographic data from **long-term experimental plots** of 7 species of grass hosts, we built **size-structured, stochastic population models** to quantify the contribution of the symbiosis on the mean and variance of long-term population growth rates.

7 Grass host species
- *Agrostis perennans*
- *Elymus villosus*
- *Elymus virginicus*
- *Festuca subverticillata*
- *Lolium arundinaceum*
- *Poa alsodes*
- *Poa sylvestris*

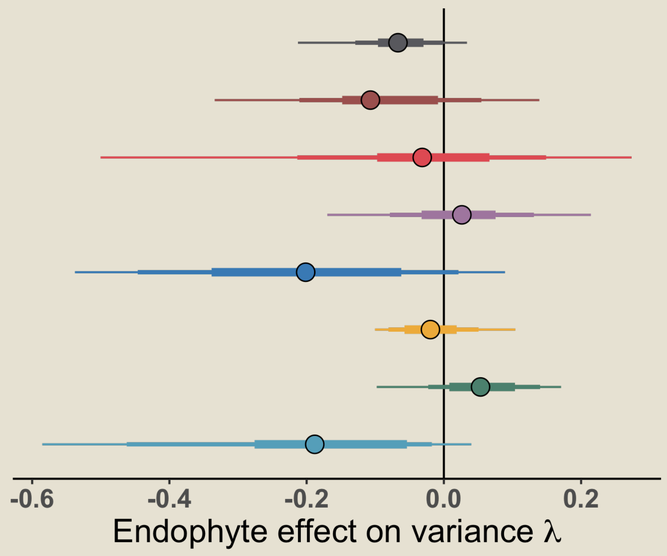
10 plots for each host species at Lillie Dickie Woods in Nashville, Indiana



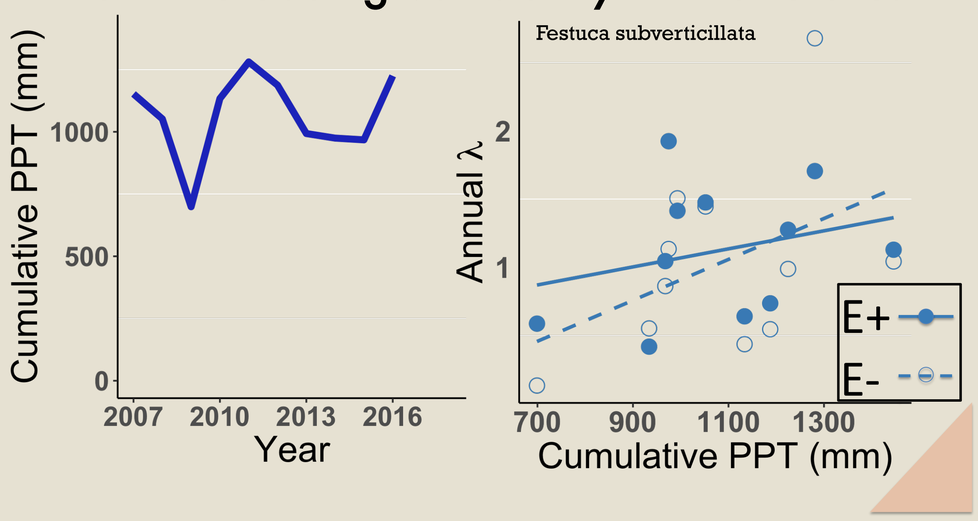
On average, endophyte partnership increases mean growth rates...



...and partially decreases variance, providing buffering.

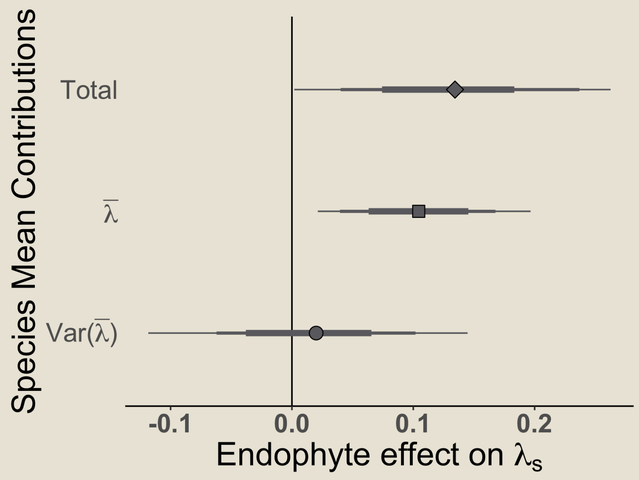


Endophyte associated hosts are less sensitive to climate and may be buffered from increasing variability in the future.



We can decompose the relative contribution of mean and variance effects on long-term stochastic growth rates.

In general, variance buffering contributes less than mean effects (~15% of Total endophyte effects).



We've learned:

- Variance buffering is common in grass – endophyte symbiosis.
- Contributions to stochastic growth rates through buffering are generally weaker than effects on the mean, but may increase in importance under climate change

See this link for select references and additional info.

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