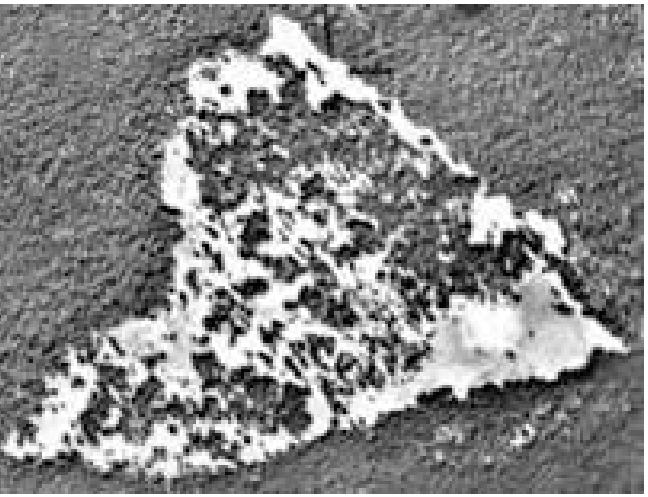
A Trait-Based Approach to Understanding Meadow Species Abundance Across a Conifer Encroachment Gradient

Meadows of the Pacific Northwest

- Only 5% of the Cascade Range of Oregon is comprised of montane meadows, but they contribute disproportionally to biodiversity in the region.

Threat to Meadow Communities

- Woody species encroachment threatens grassland ecosystems worldwide: Europe, Australia, South America, and North America, Africa
- In this region there has been as much as 50% meadow contraction in the last 60 years.
- With time forest understory species replace meadow species.



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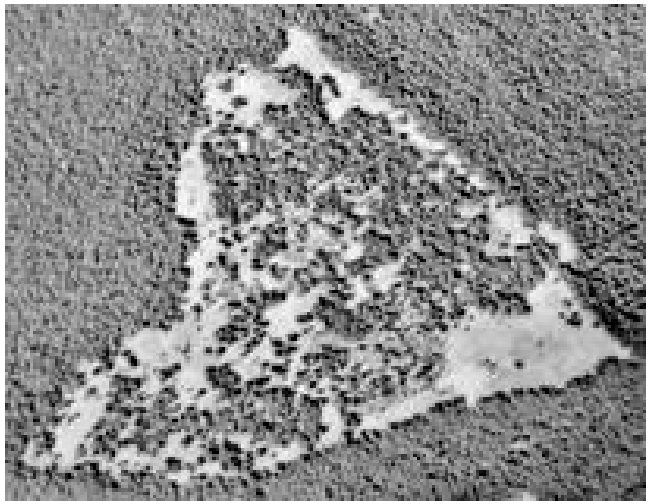

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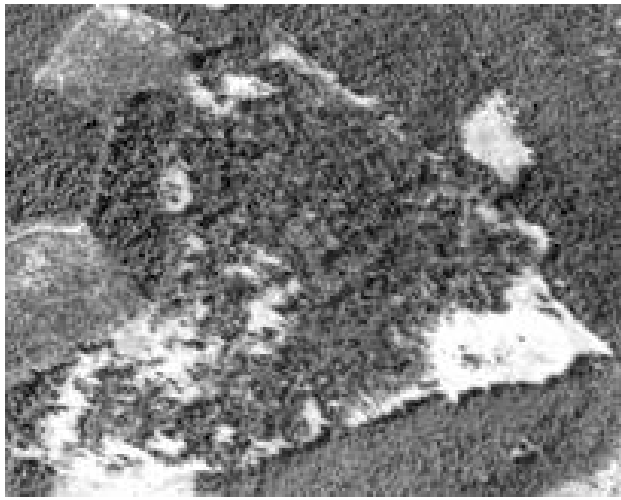
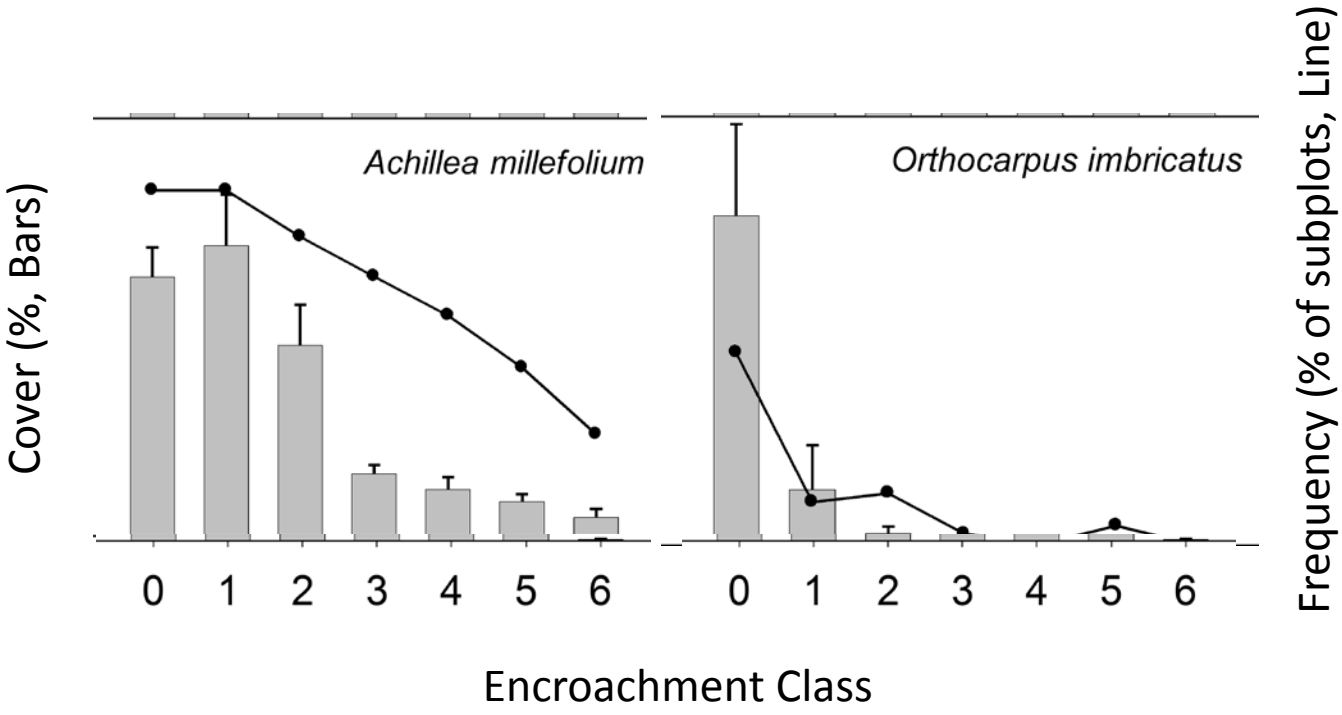


2000

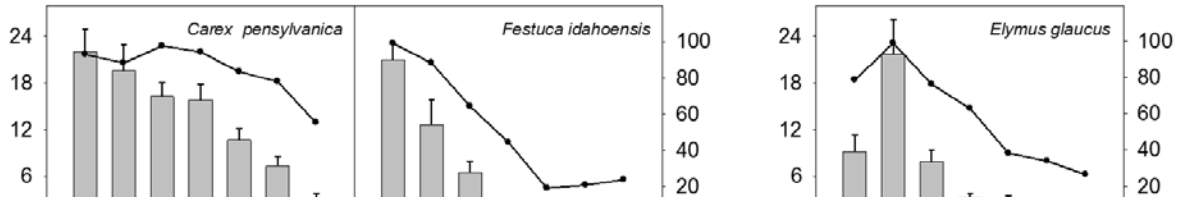
Species Response to Encroachment

- Some meadow species survive in the understory even after a century of encroachment, some drop out after just 10-20 years.

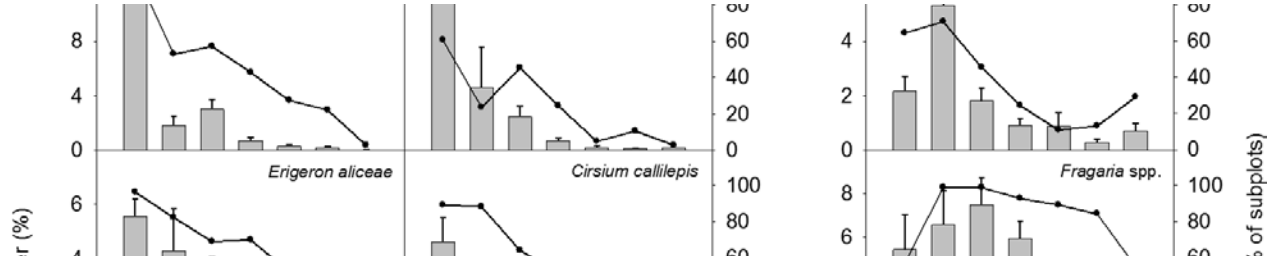


Haugo and Halpern 2007

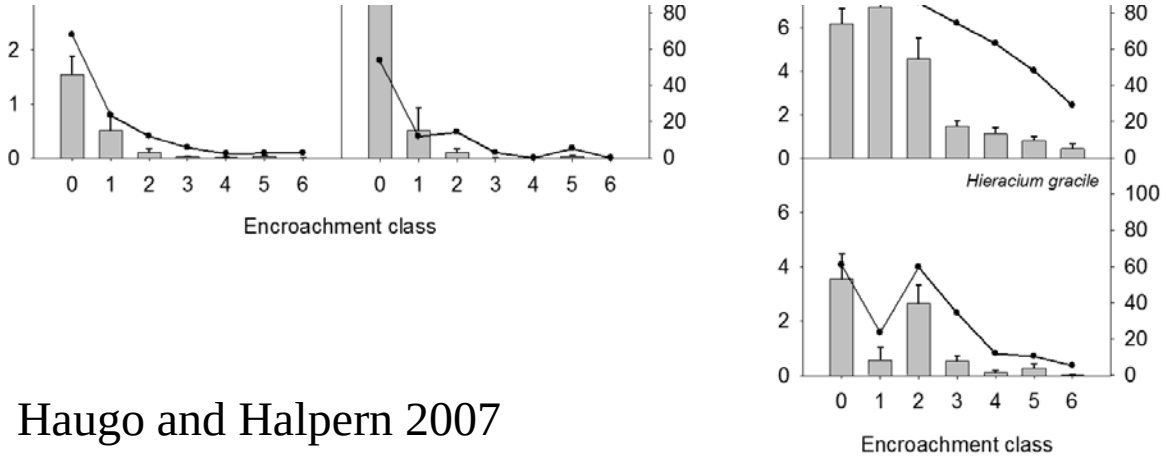
Species Response to Encroachment



Can plant functional traits explain this variation in sensitivity?



Specifically, is species sensitivity to encroachment related to species ability to adjust their traits?



Haugo and Halpern 2007

Plant Functional Traits

“Plant functional traits are features that represent ecological strategies and determine how plants respond to environmental factors, affect other trophic levels and influence ecosystem properties.” (Perez-Harguindeguy et. al. 2013)

Selected Trait

Specific Leaf Area (SLA)= fresh leaf area/ dry mass

-Allows for more light capture

-Enhances carbon gain

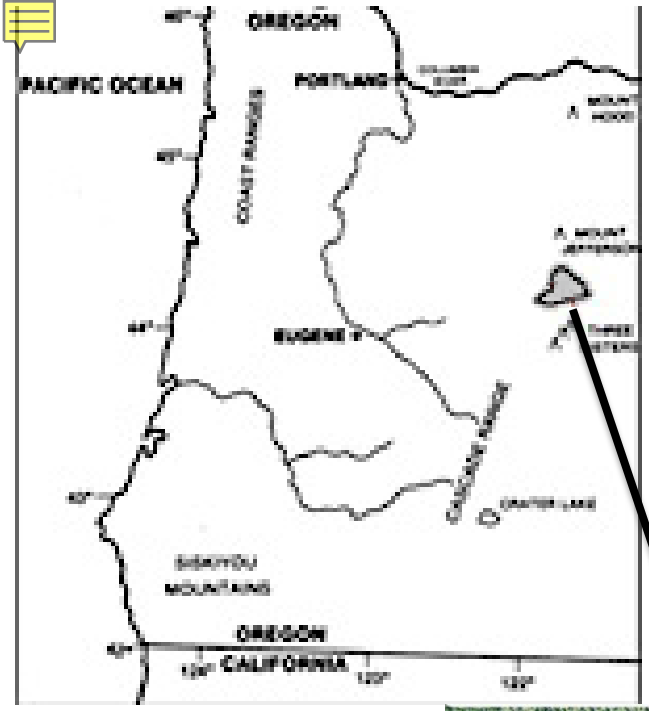
Hypothesis

Species that are less sensitive to encroachment will…

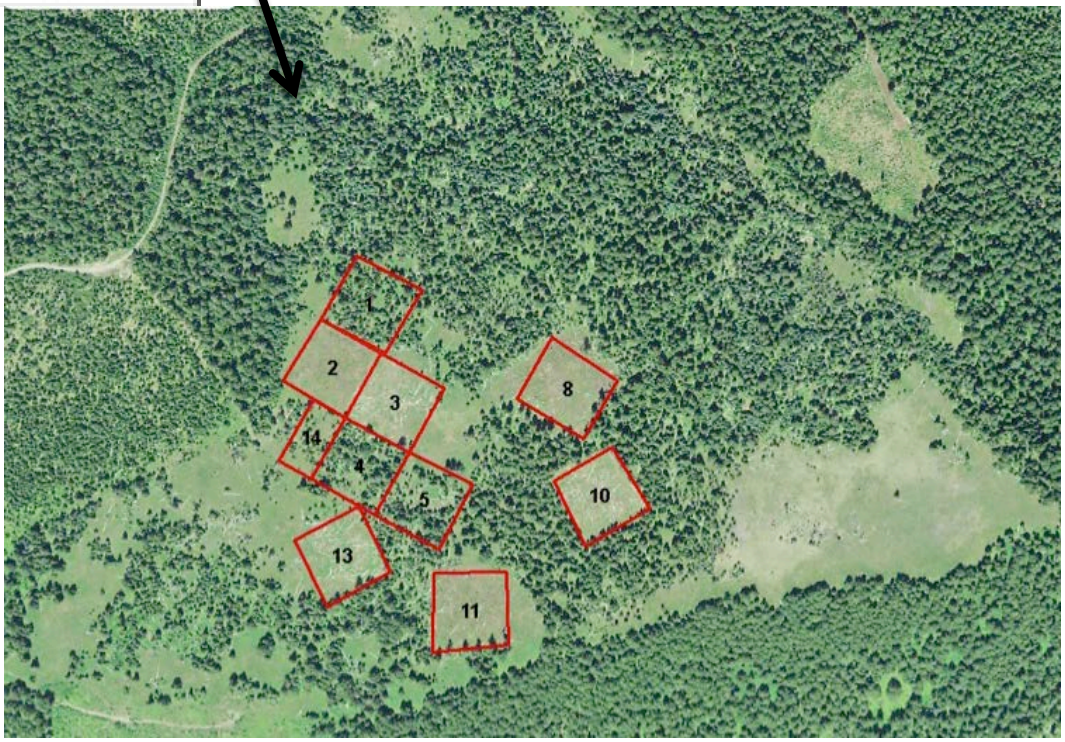
be more variable in SLA

$$\frac{\text{Leaf Area}}{\text{Leaf Mass}}\ \begin{matrix}-\\+\end{matrix} \longrightarrow \frac{\text{Leaf Area}}{\text{Leaf Mass}}\ \begin{matrix}+\\-\end{matrix}$$

Bunchgrass Ridge



- Located on the boundary of the Western and High Cascades.
- Dominated by *Pinus contorta* and *Abies grandis.*
- Soils are deep, fine sandy loams and profiles indicate that meadows have dominated for centuries.

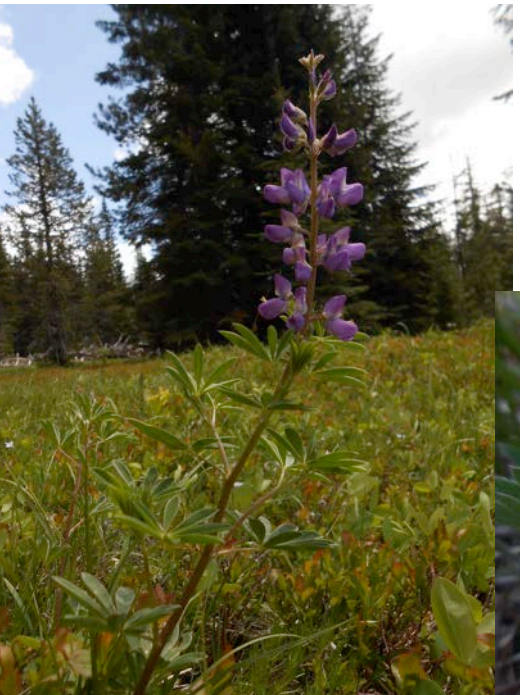


Data Analysis

Pearson's Correlation

Sensitivity → SLA Variability

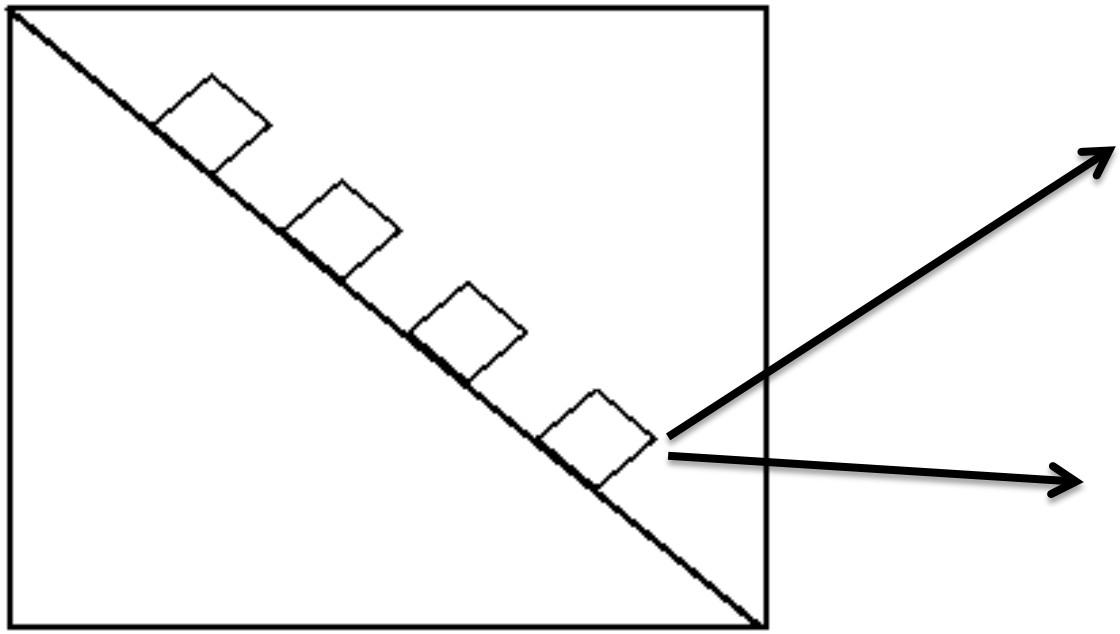
But first….



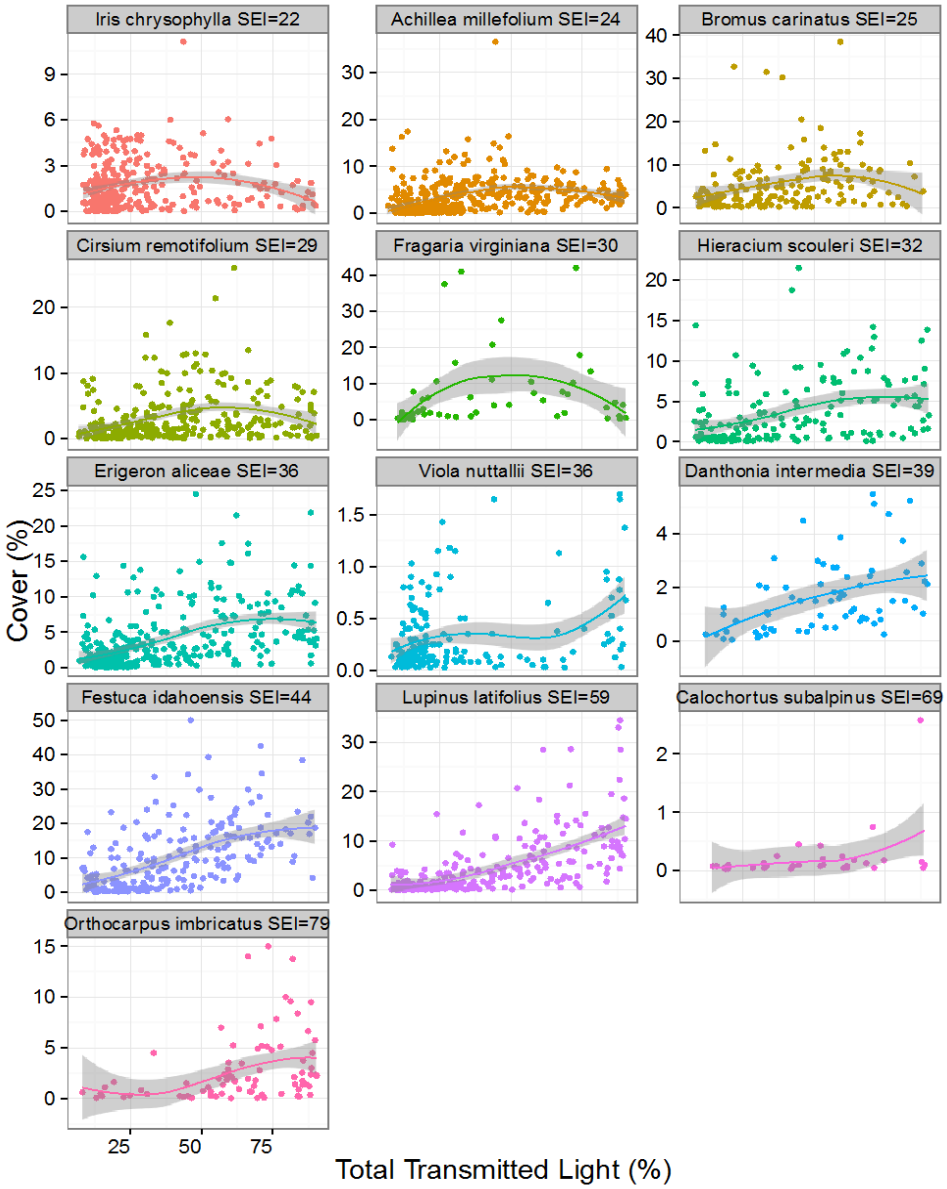
Methods: Species Selection

- We chose 13 species to represent a range of sensitivity to encroachment.
- 15-17 mature individuals of each species was chosen for trait measurement
- Light measurements were taken above each plant sampled

Methods: Species Sensitivity

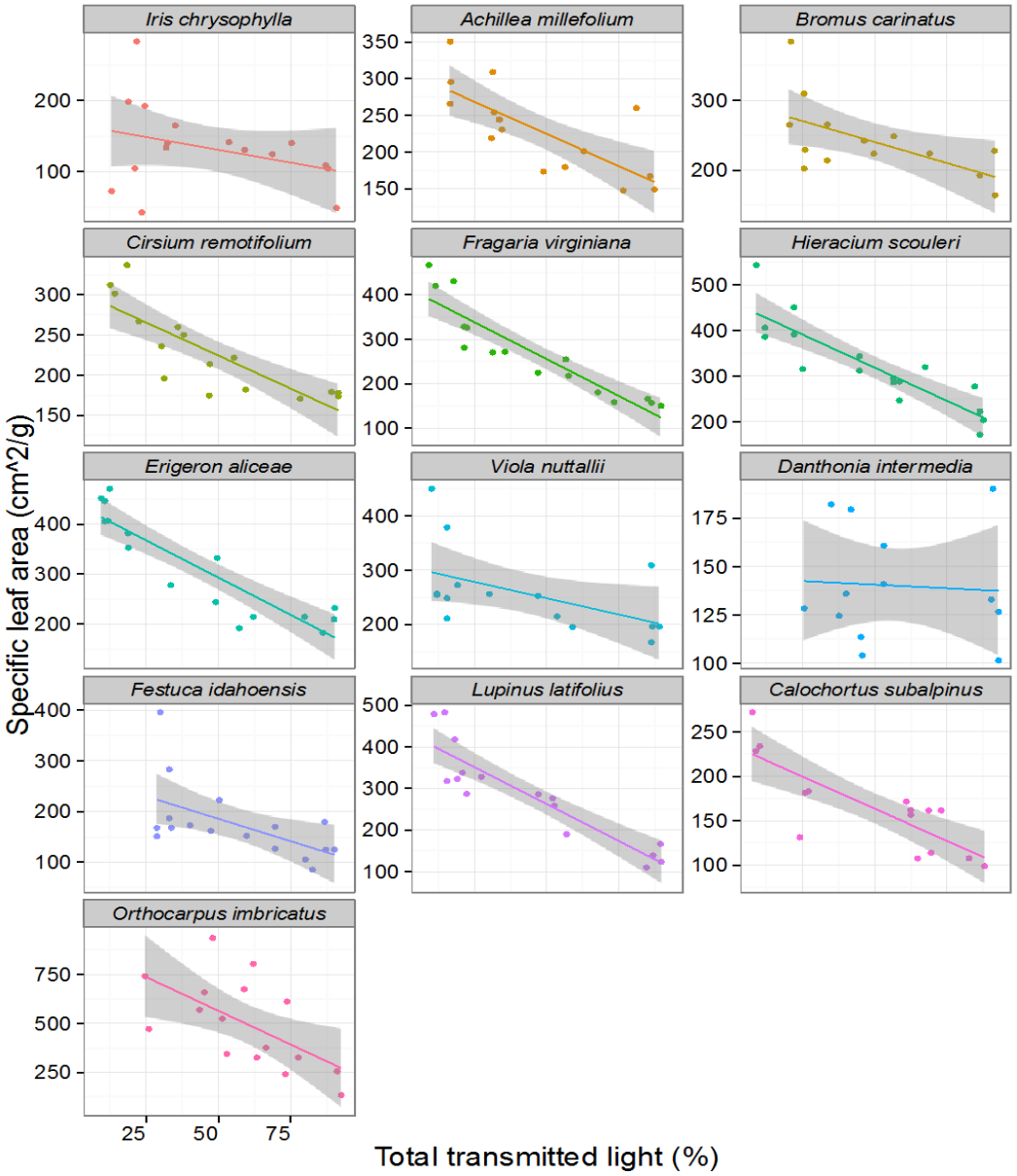


Sensitivity to Encroachment



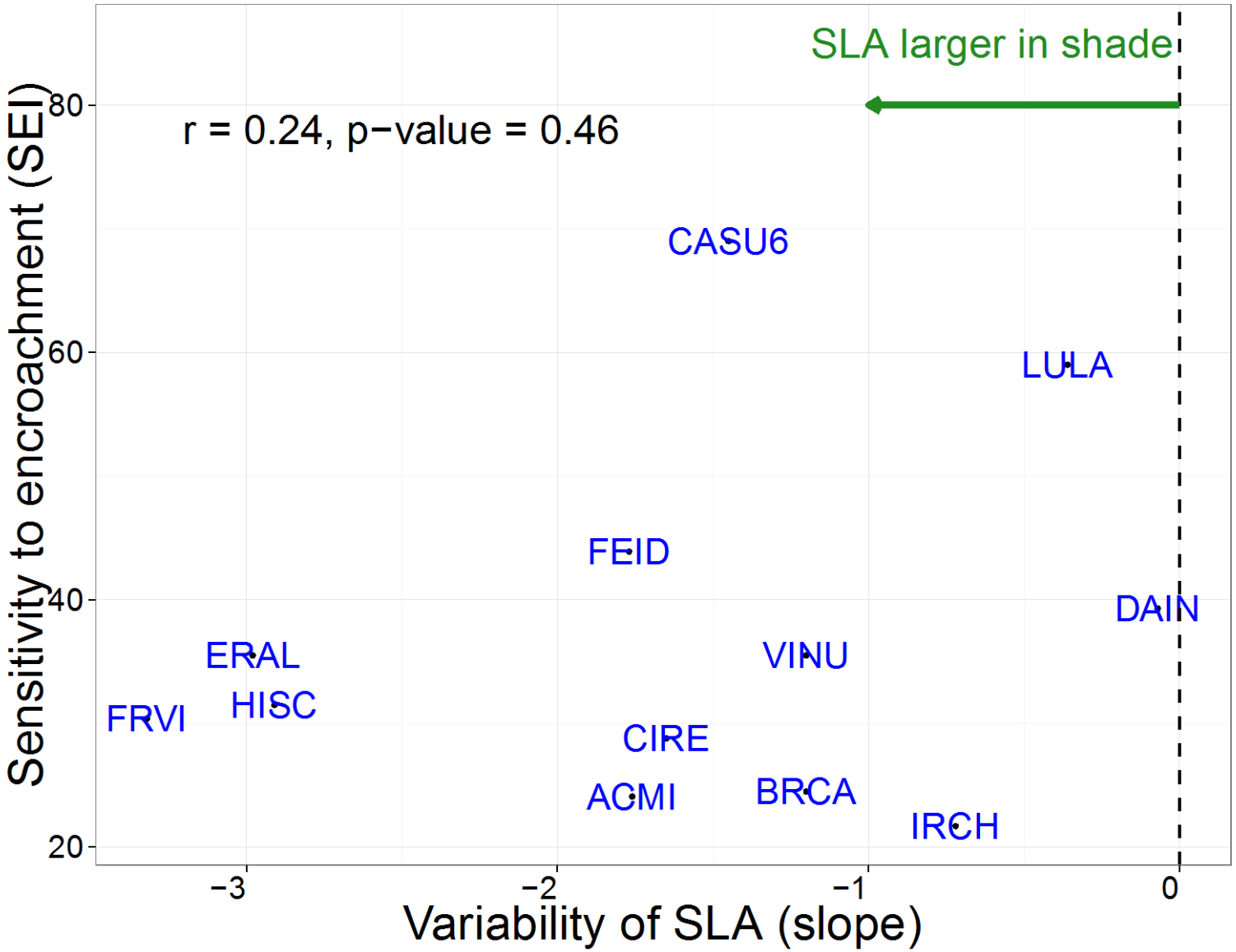
- Fit species abundance and light data to a local model.
- Calculated the Coefficient of Variation of the predicted values and used this to describe species sensitivity.

Methods: SLA Variability

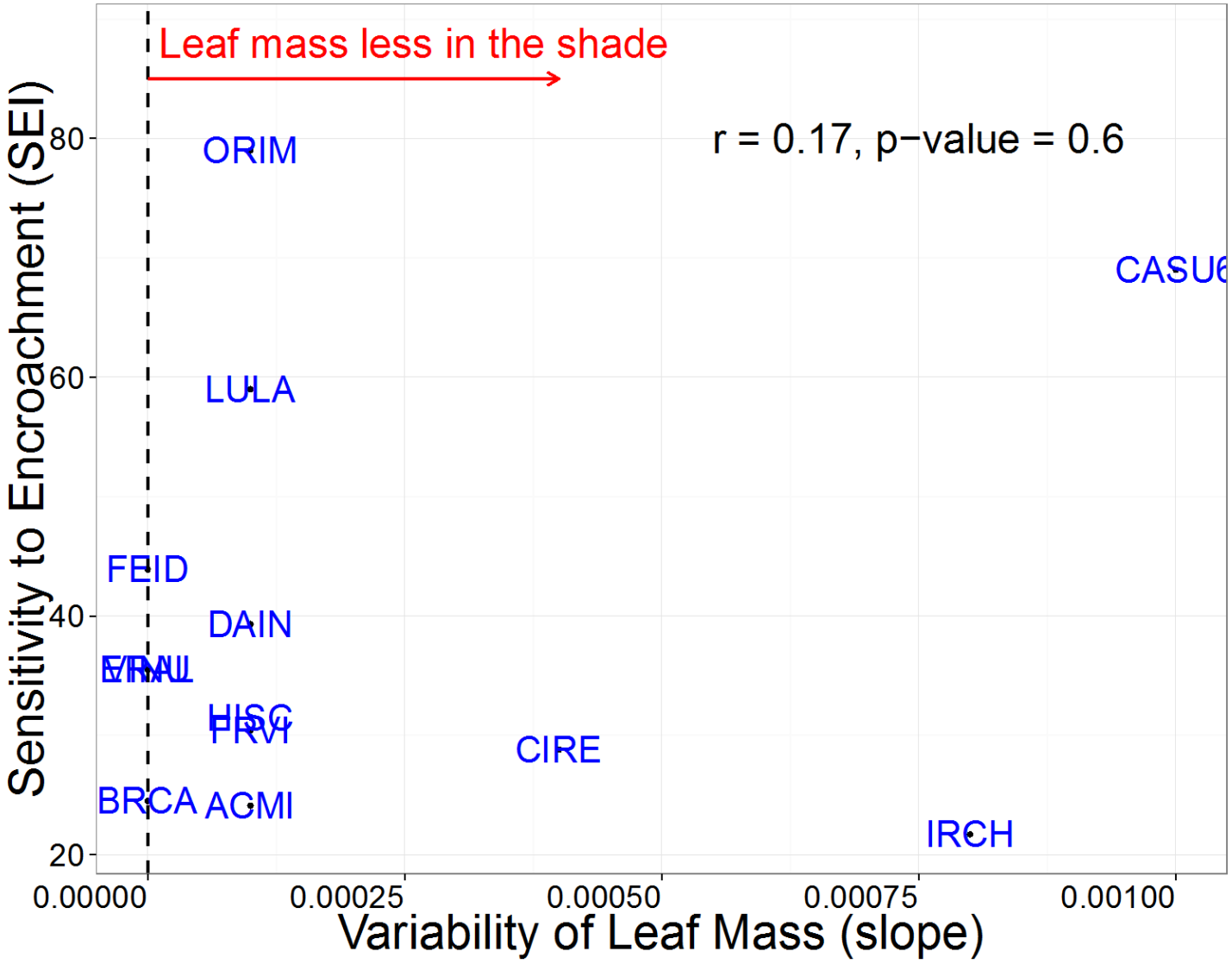


- Used slopes of linear models to get a picture of the magnitude and direction of SLA variability
- The steeper the slope the greater the variability
- Direction of the slope indicates type of response
  (+)=stress response
  (-)= adaptive response

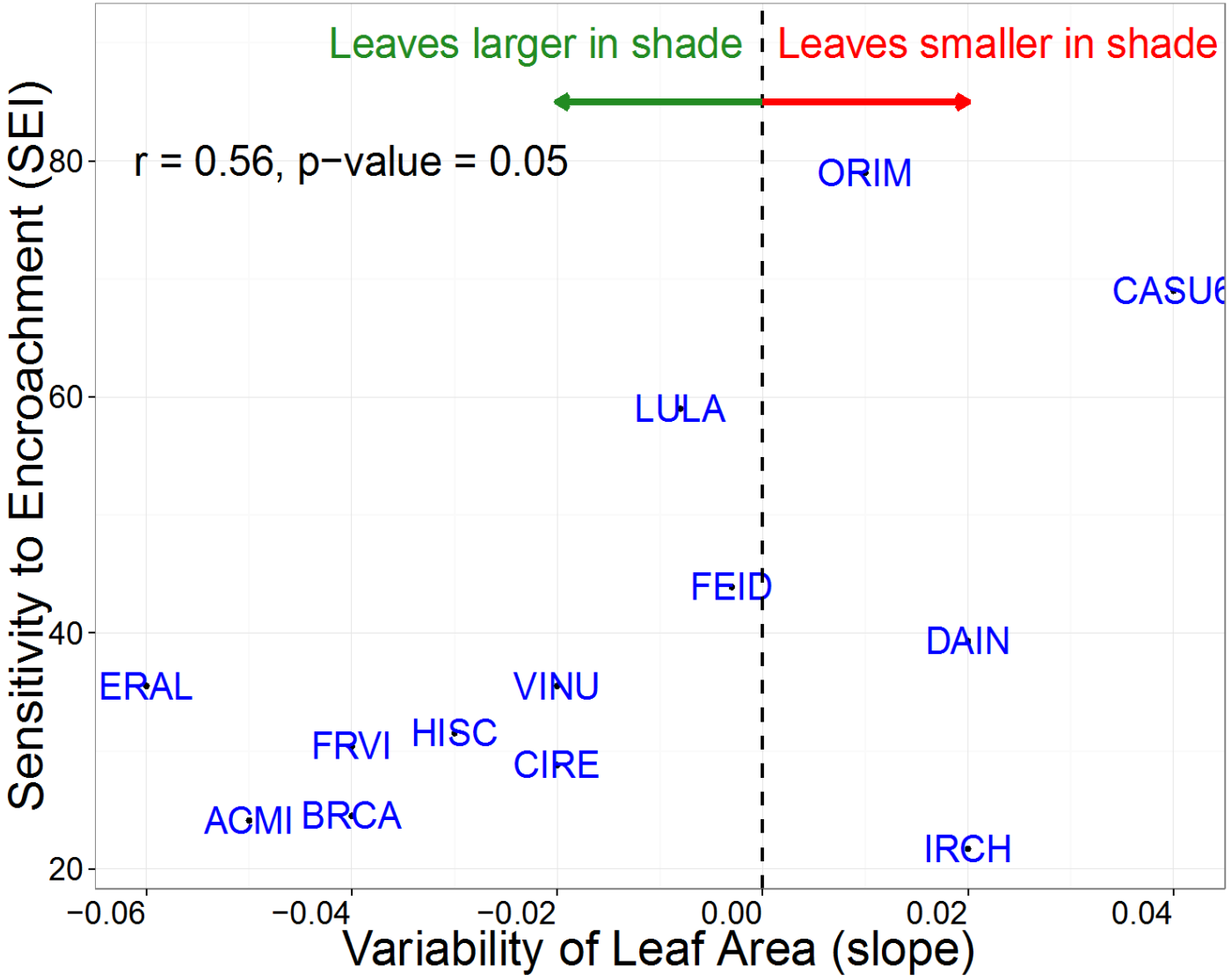
Results: SLA Variability



Results: Leaf Mass Variability



Results: Leaf Area Variability



Conclusions

- SLA: while all species had an adaptive response to limited light, leaf area gave a better picture of the individual reactions of species.

- Overall, the traits we chose to measure provided little evidence that trait variability is related to species sensitivity to encroachment.

Conclusions

- Future studies should focus on physiological leaf traits like dark respiration and photosynthetic activity.
- Additional explanatory variables could also help illustrate species sensitivity to encroachment.

Acknowledgements

Advisors

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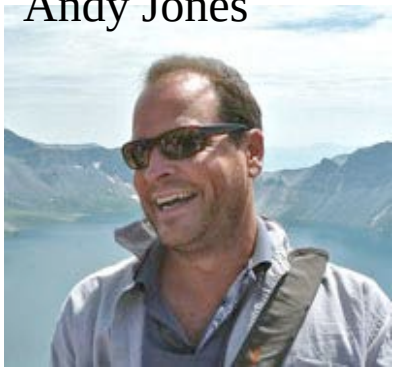

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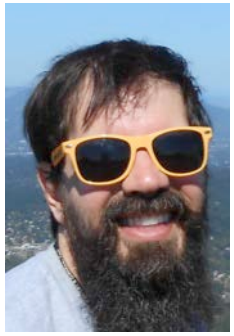

Writing Support Team

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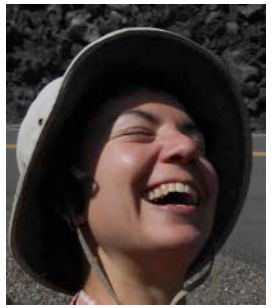

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Questions?