



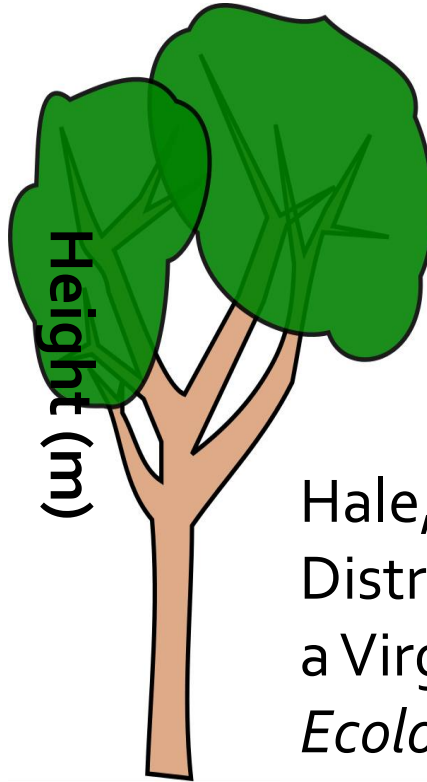
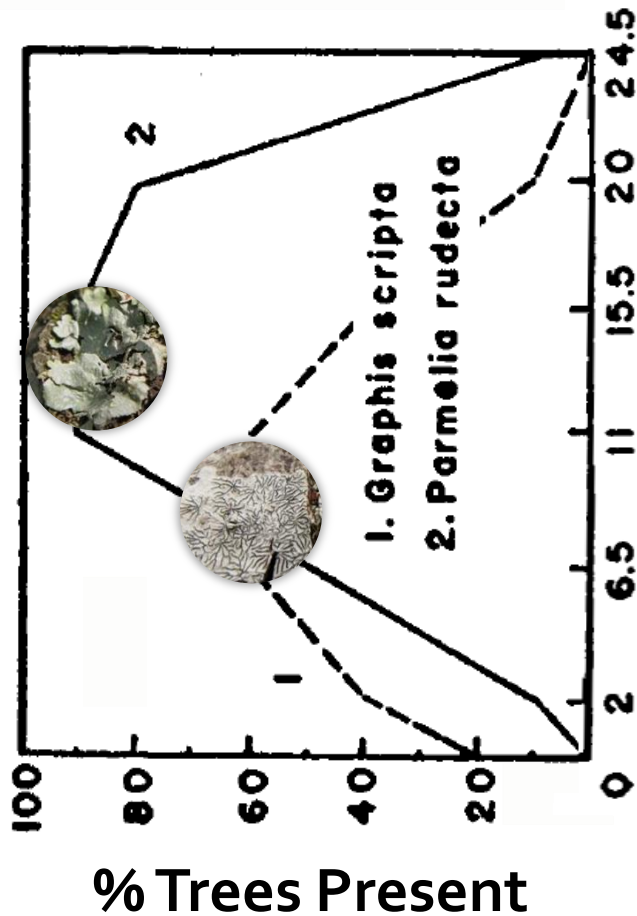
**Does canopy  
microclimate  
structure lichen  
epiphyte  
communities?**

**Evidence from intra- versus interspecific  
variation in functional traits**

Jes Coyle, Dept. of Biology, University of North Carolina at Chapel Hill



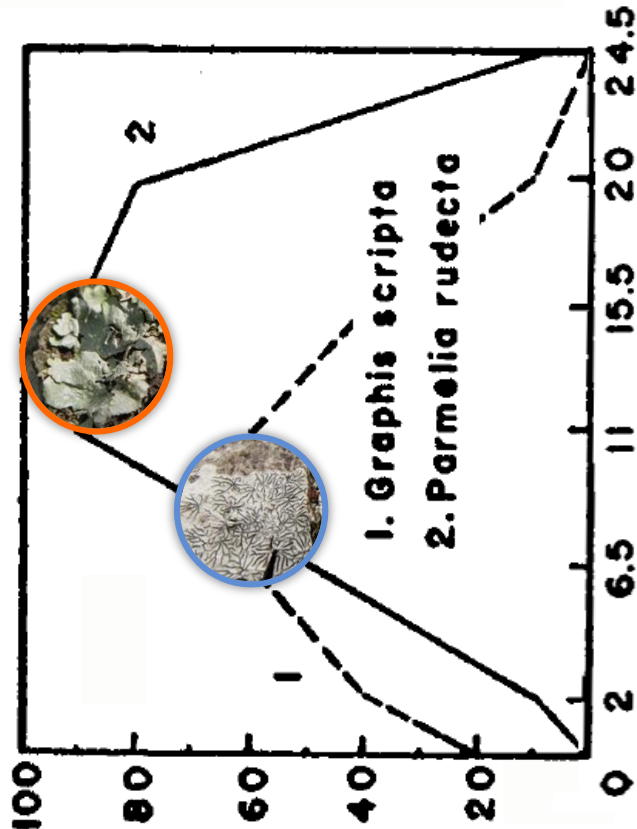




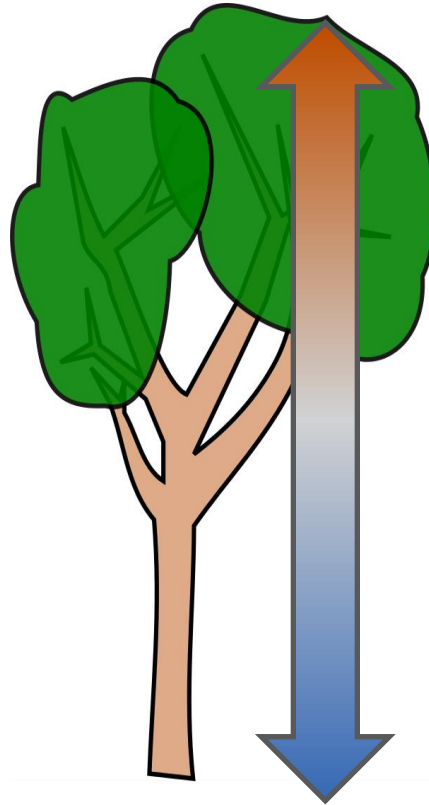
Hale, ME. **1952**. Vertical Distribution of Cryptogams in a Virgin Forest in Wisconsin. *Ecology* 33(3): 398-406



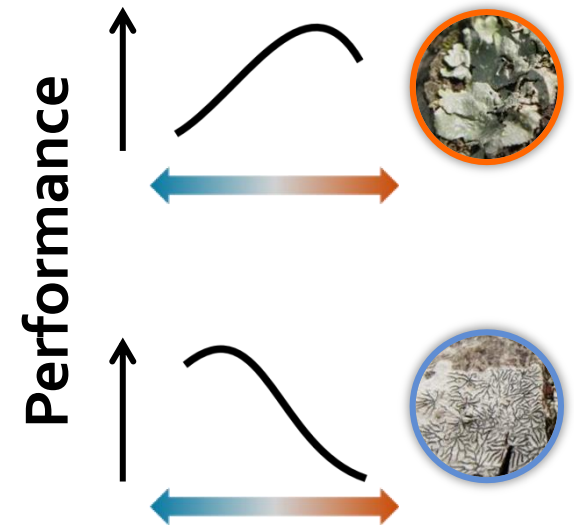
# Hypothesis:



Distributional  
differences

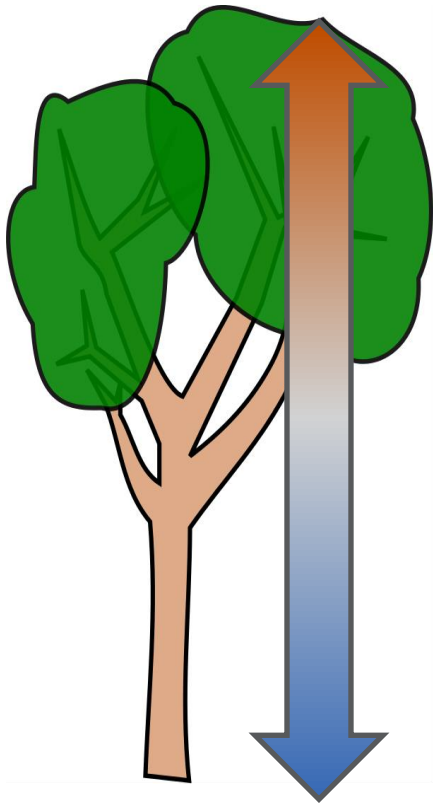


Environmental  
variation



Niche  
differences

*If canopy microclimates filter lichen communities...*

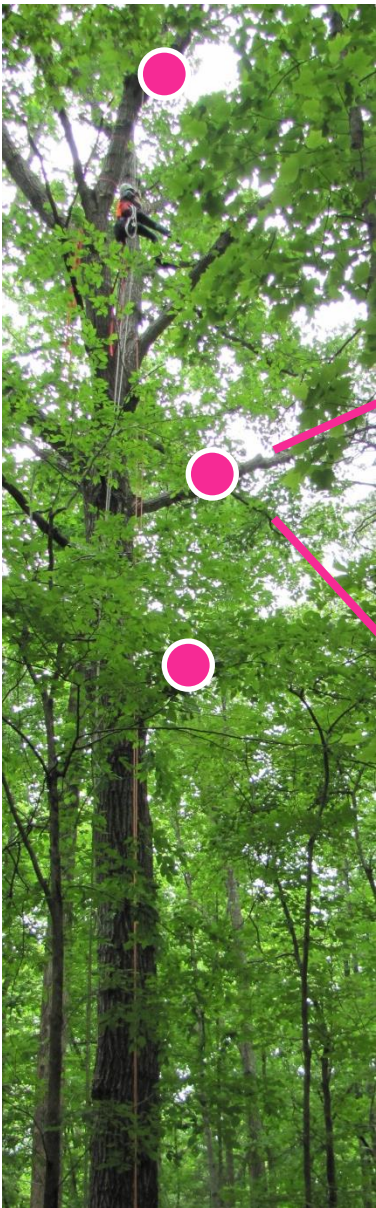


Variation in relevant  
functional trait...

1

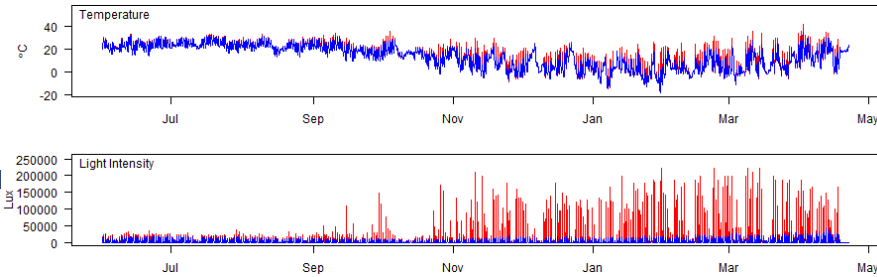
...that differs among  
species

2



10 trees

### 3 branches



Frequency of full sunlight  
Mean vapor pressure deficit (VPD)

### 2 samples



515 thalli  
11 genera  
7 traits



3 branches

Mariah Goodman

Brian Sherman

Michael Auriemma

Shelly Guo

Miguel Sandoval

Water Dog Farms

Duke Forest

Allen Hurlbert

Charles Mitchell

Joel Kingsolver

Francois Lutzoni

Bob Peet

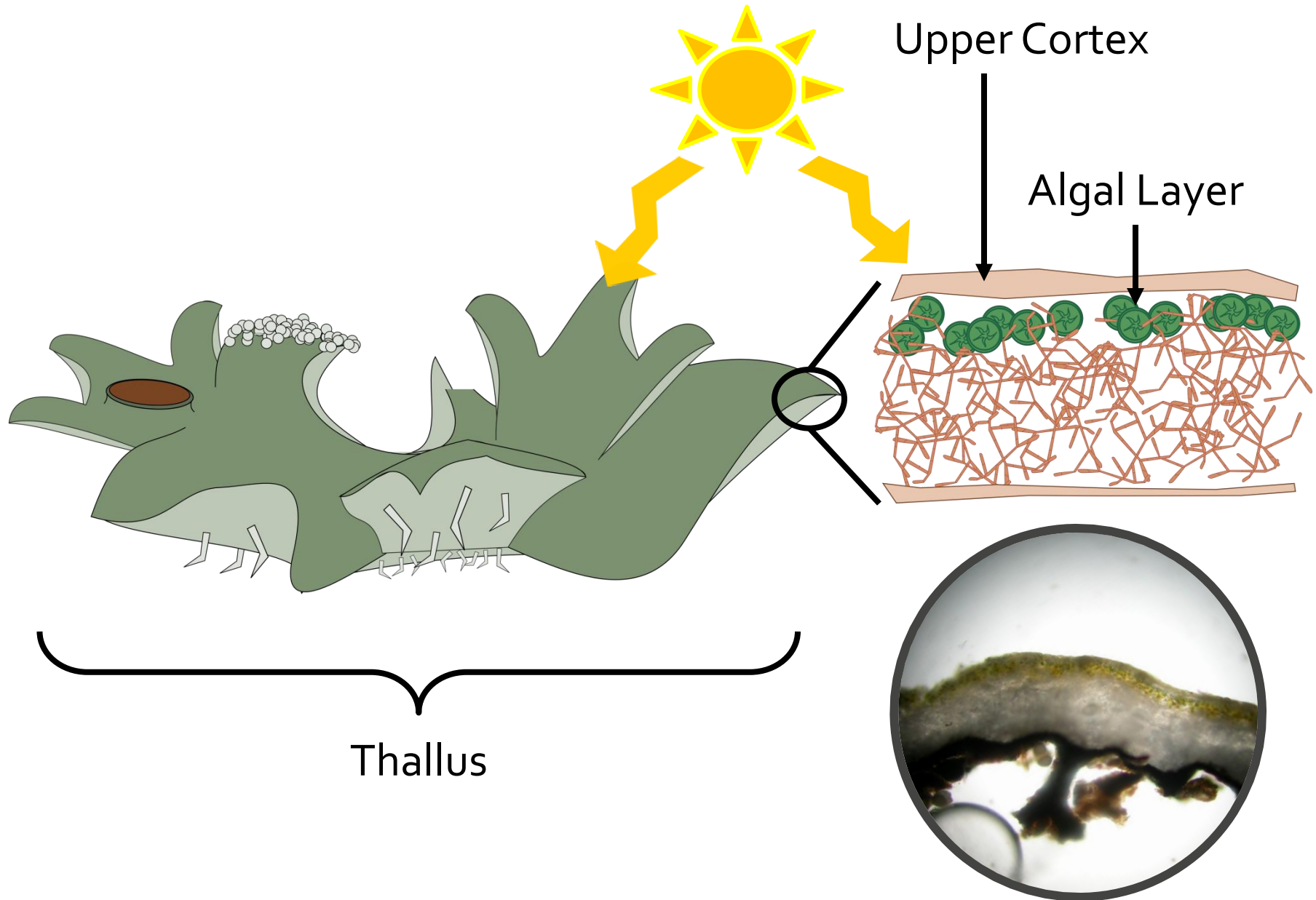
National Science Foundation

Royster Society of Fellows



10 trees

# Lichen Anatomy Basics



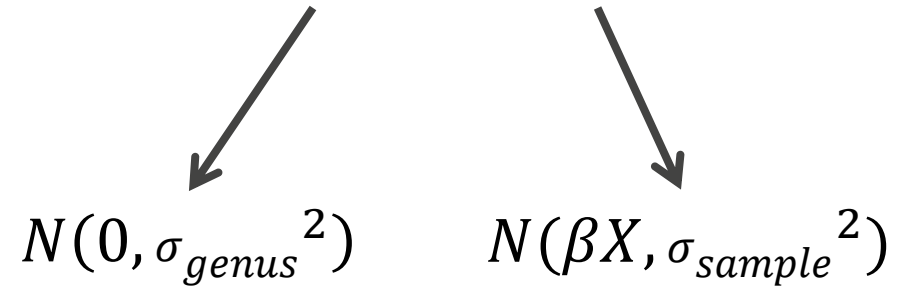


**Does cortex  
thickness vary  
with light and  
humidity?**

**Does this  
environmental  
constraint alter  
community  
structure?**

Linear models of individual traits:

$$\log( \textit{Cortex thickness}_i ) \sim N( \textit{Genus} + \textit{Sample}, \sigma^2 )$$





The diagram illustrates the decomposition of the linear model. Two arrows point from the terms 'Genus' and 'Sample' in the equation above to their respective normal distributions below. The 'Genus' term is associated with a normal distribution centered at 0 with variance  $\sigma_{genus}^2$ . The 'Sample' term is associated with a normal distribution with mean  $\beta X$  and variance  $\sigma_{sample}^2$ .

$$N(0, \sigma_{genus}^2) \qquad N(\beta X, \sigma_{sample}^2)$$

Linear models of individual traits:

$$\log( \textit{Cortex thickness}_i ) \sim N( \textit{Genus} + \textit{Sample}, \sigma^2 )$$

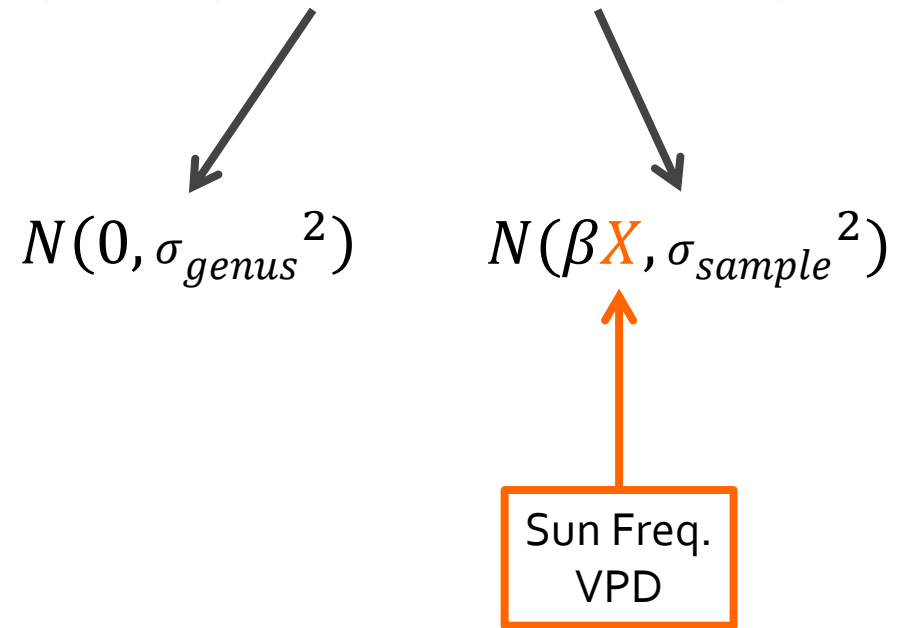

$$N(0, \sigma_{\textit{genus}}^2)$$


$$N(\beta X, \sigma_{\textit{sample}}^2)$$



Linear models of individual traits:

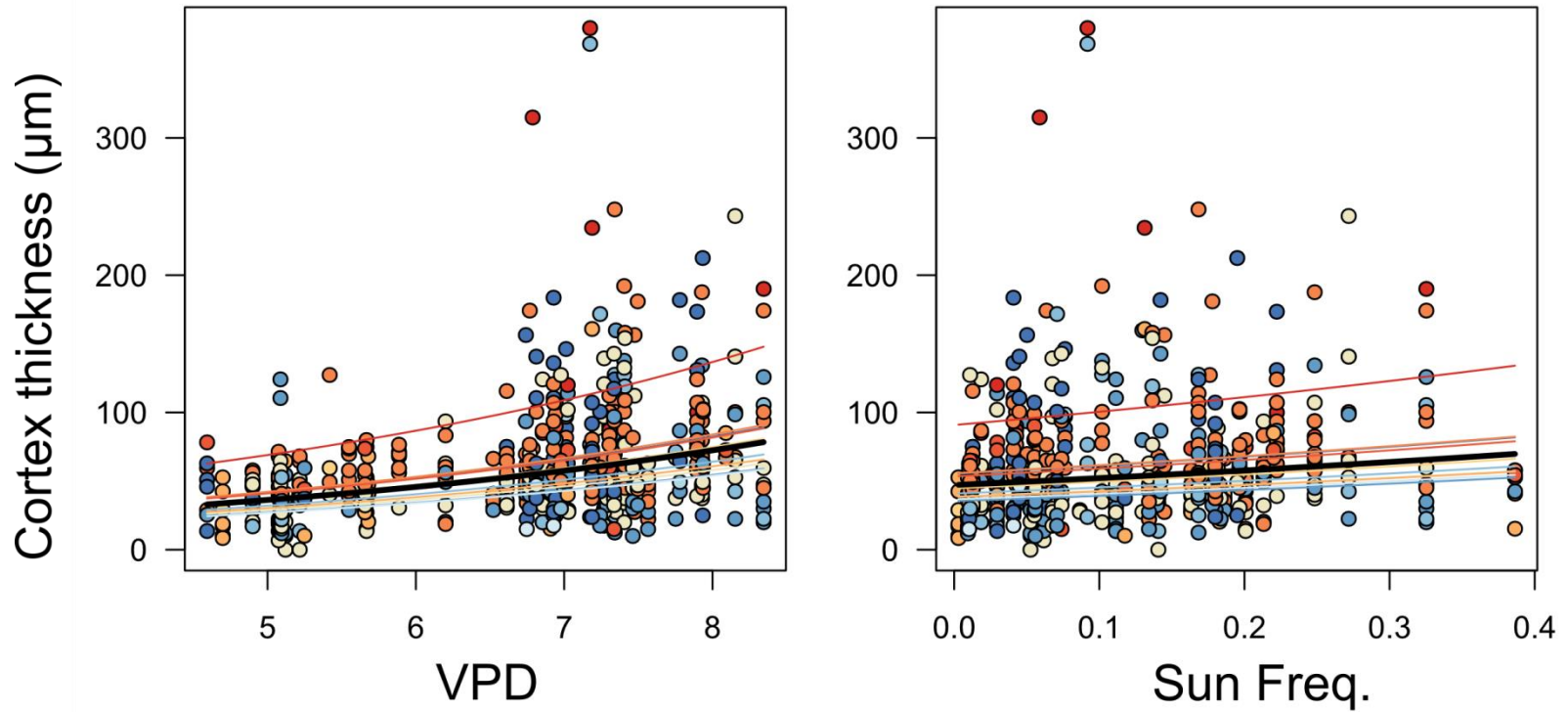
$$\log(\text{Cortex thickness}_i) \sim N(\text{Genus} + \text{Sample}, \sigma^2)$$


$$N(0, \sigma_{\text{genus}}^2)$$

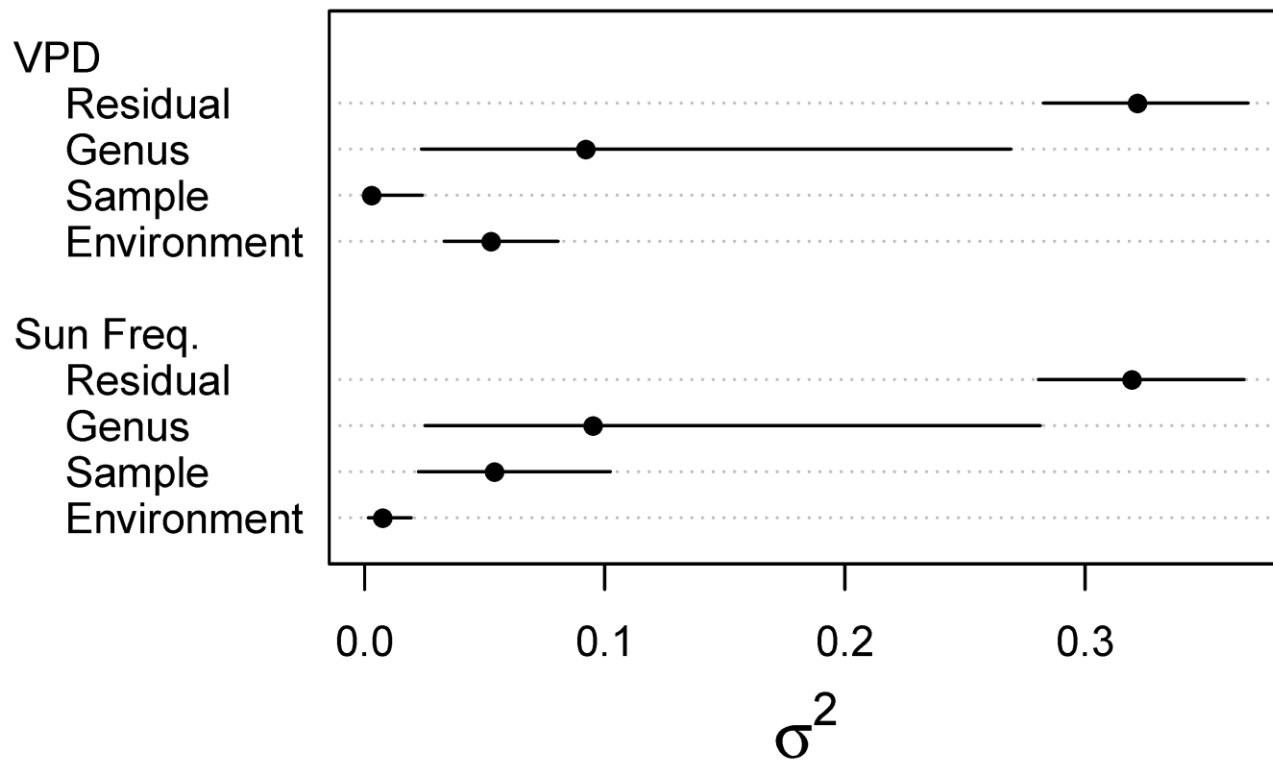
$$N(\beta X, \sigma_{\text{sample}}^2)$$

Sun Freq.  
VPD

# Does cortex thickness vary with light and humidity?



## Does cortex thickness vary with light and humidity?

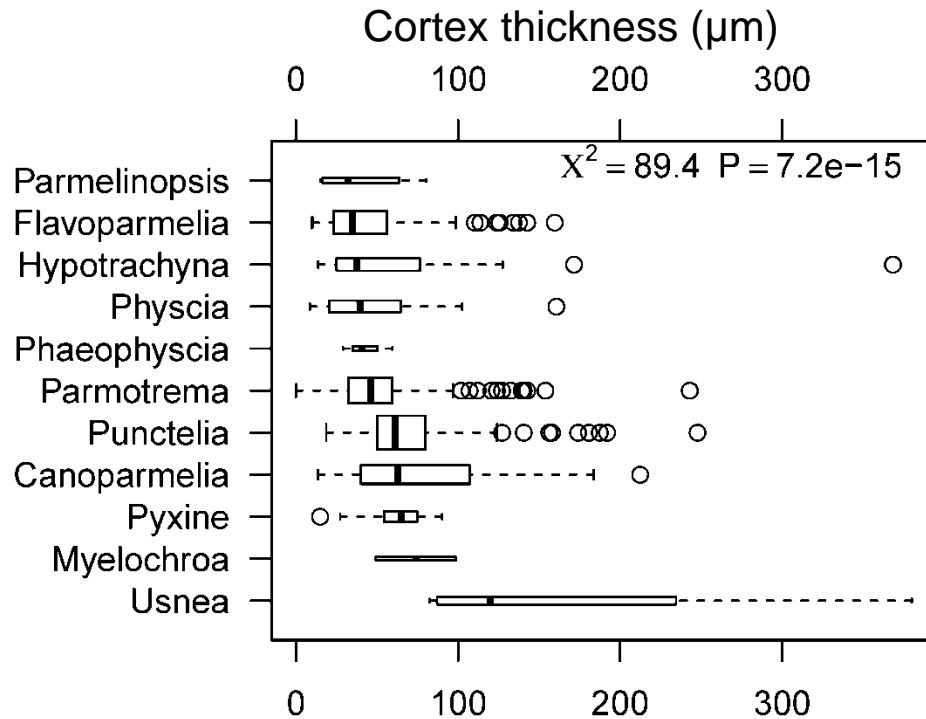




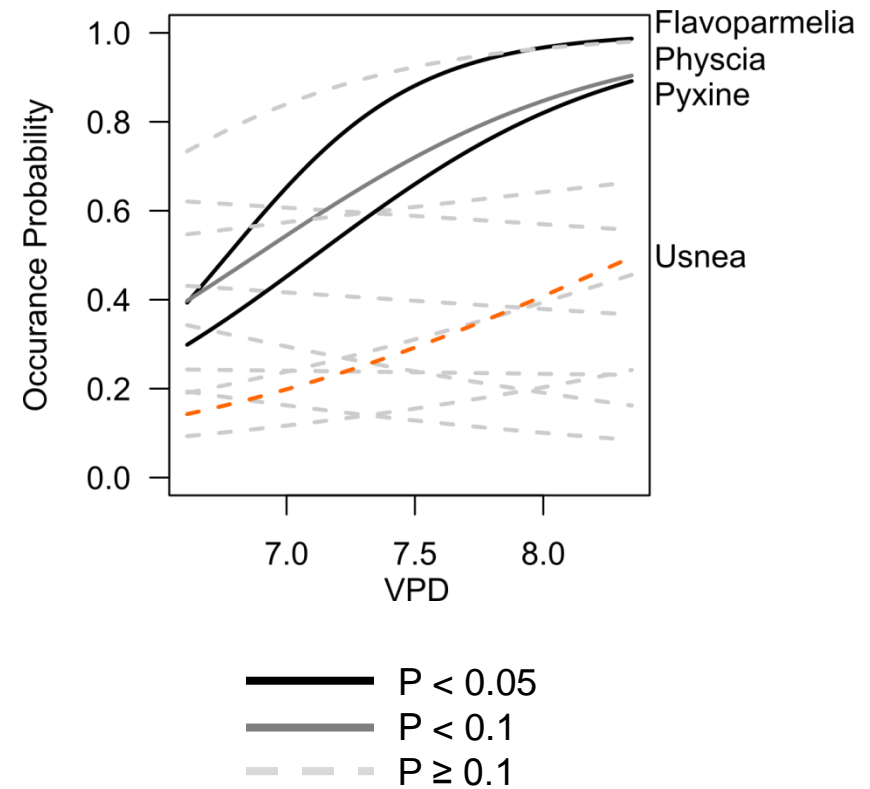
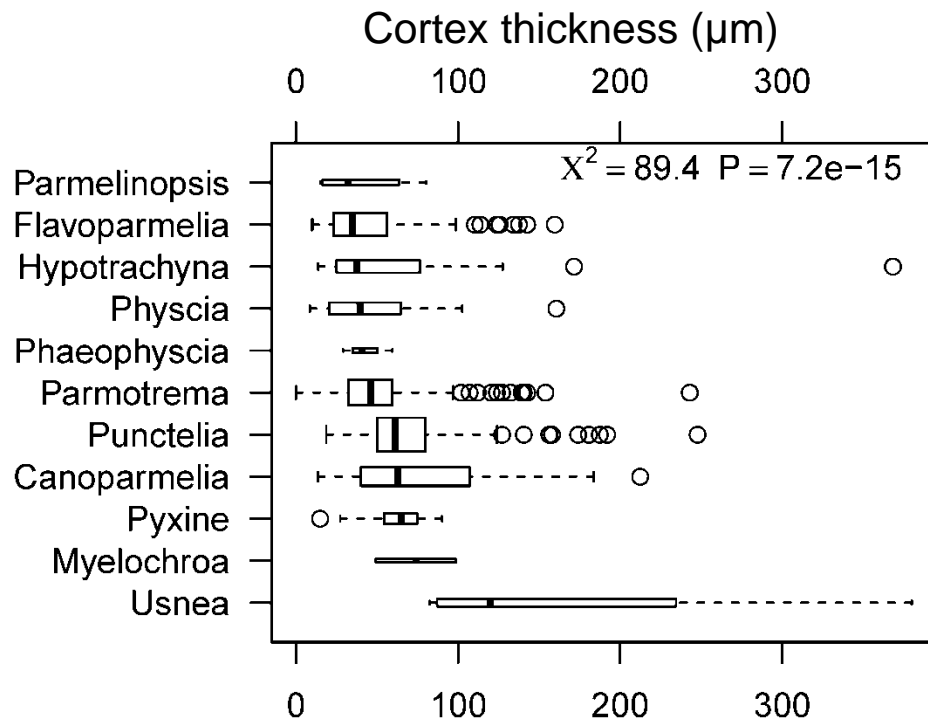
2

Does this environmental constraint alter community structure?

## Does this environmental constraint alter community structure?



## Does this environmental constraint alter community structure?

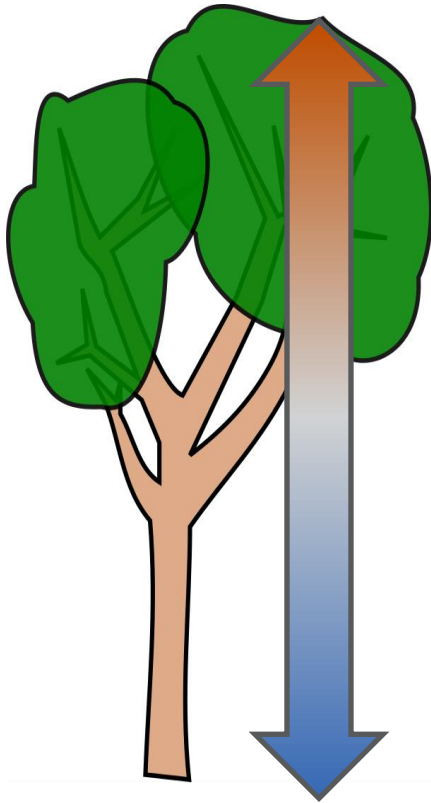




CCA of species composition:

	Community Variation Explained
Ordination constrained by <b>VPD</b>	<b>3.5%</b>
Ordination constrained by <b>Sun Freq.</b>	<b>1.2%</b>

*If canopy microclimates ~~filter~~ lichen communities...*



~

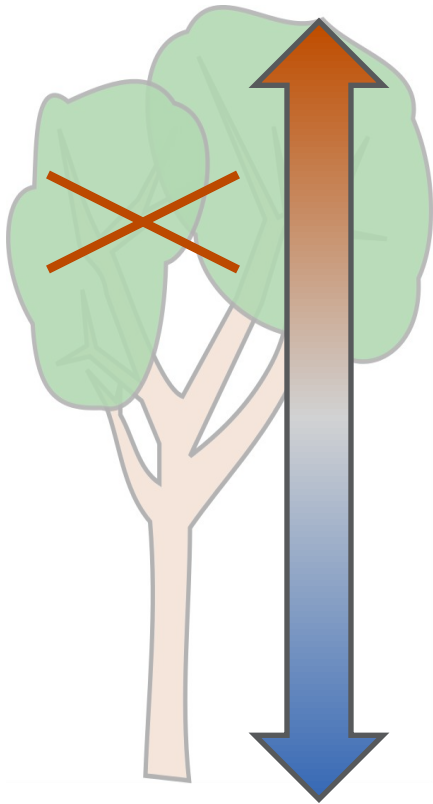
Variation in relevant  
functional trait...

1

...that ~~differs~~ among  
species

2

*If canopy microclimates ~~filter~~ lichen communities...*



~

Variation in relevant  
functional trait...

1

...that ~~differs~~ among  
species

2



*What structures  
lichen epiphyte  
communities?*





*What structures  
lichen epiphyte  
communities?*

Traits?





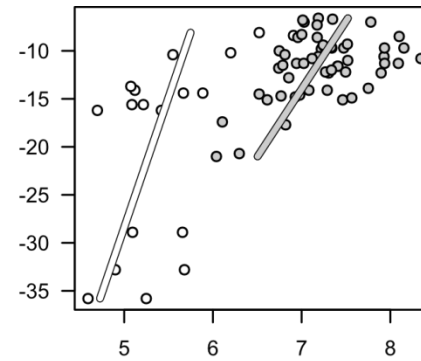
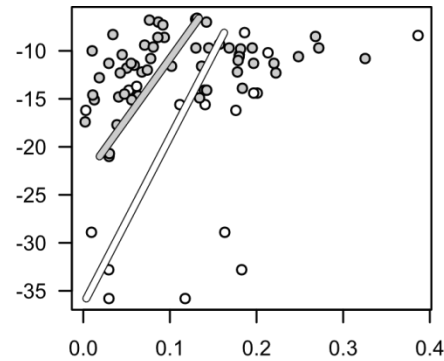
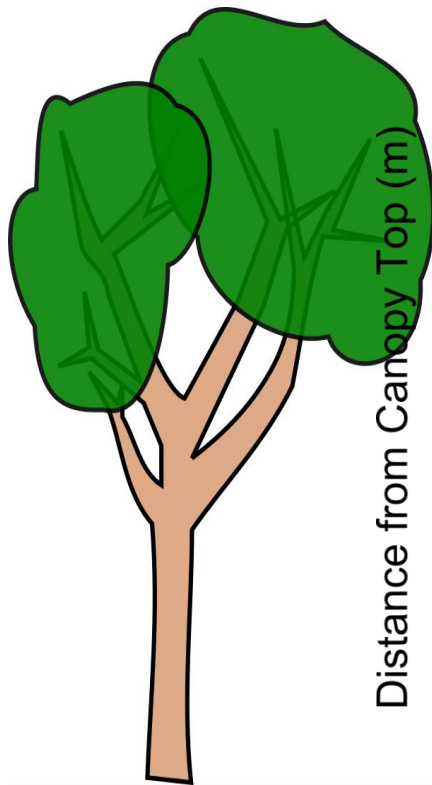
*What structures  
lichen epiphyte  
communities?*

Traits?

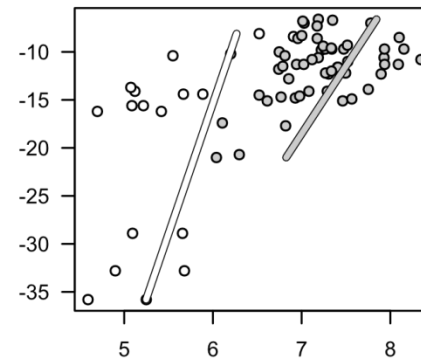
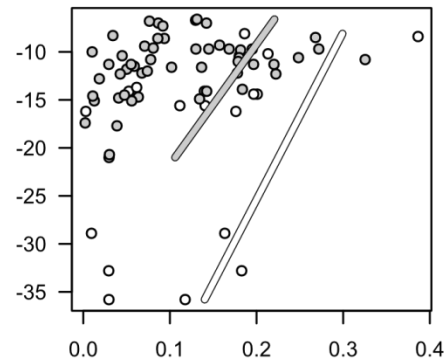
Questions? [jes.r.coyle@gmail.com](mailto:jes.r.coyle@gmail.com) @jescoyle



Predicted environmental variation with canopy height, surface angle, and site:



Vertical  
Surface



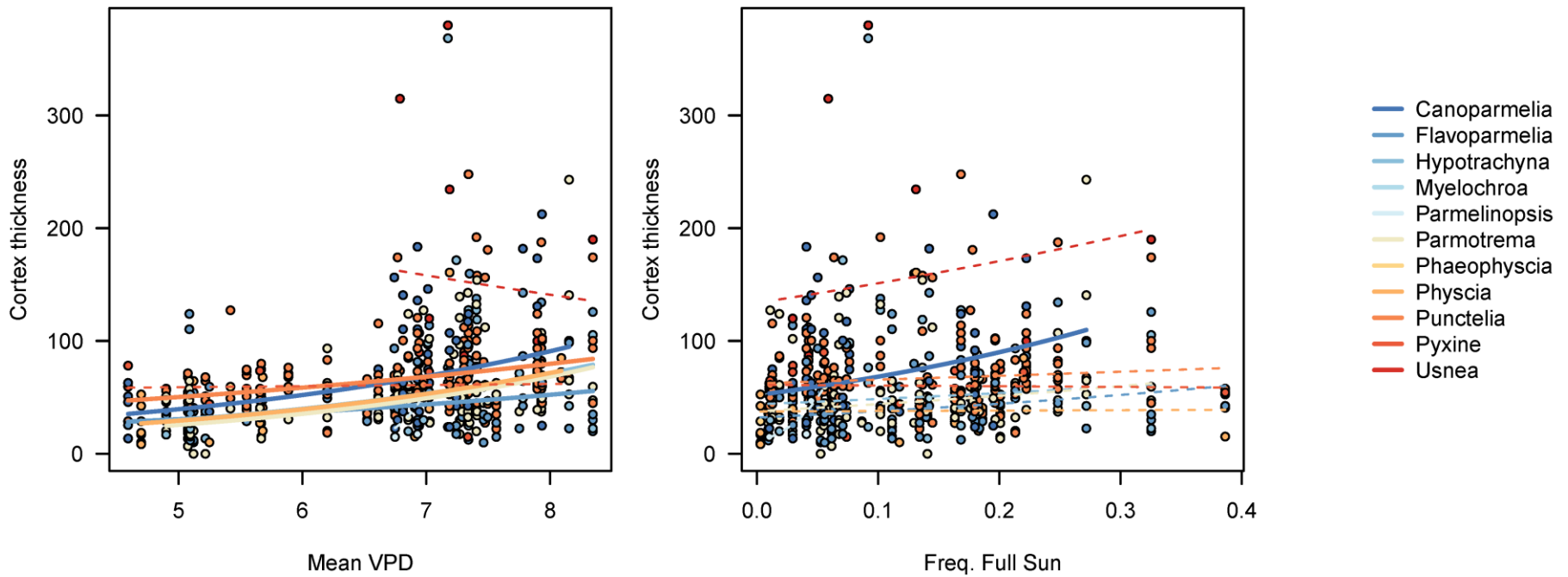
Horizontal  
Surface

Sun Freq.

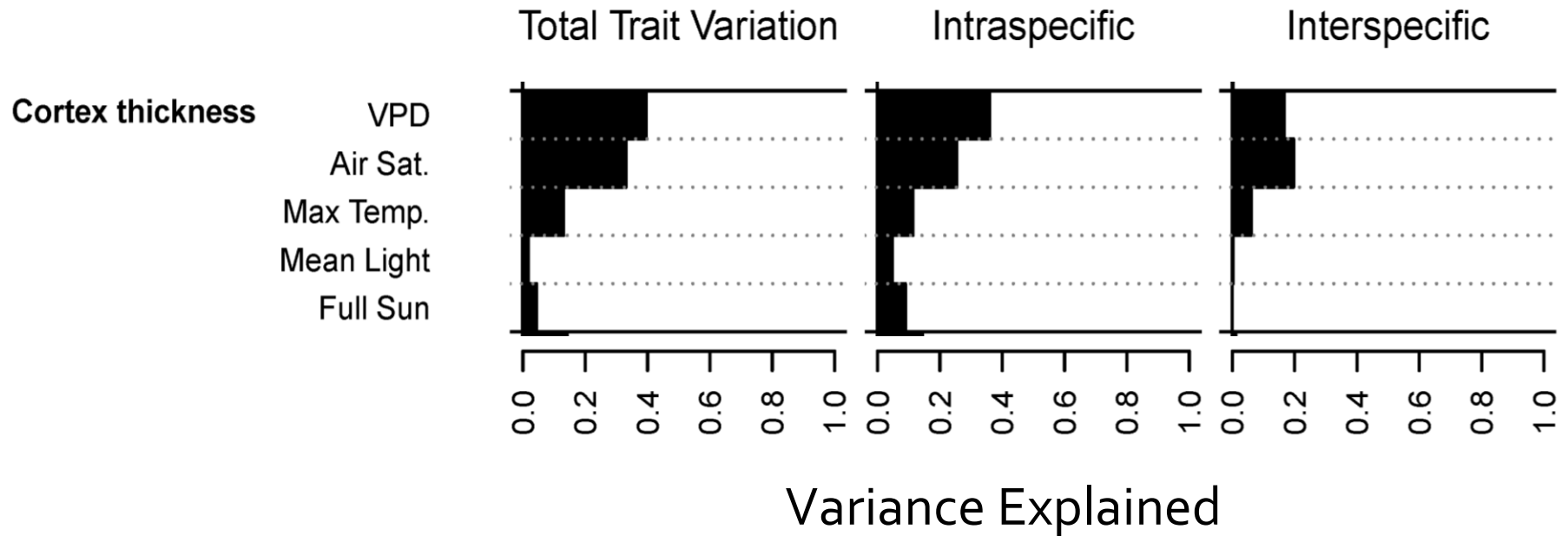
VPD



# Models fit to genera separately:



# Community mean trait variation:



# Community mean trait variation:

