

Functional Ecology of Cryptogams: Scaling from the Traits of Bryophytes, Lichens and Soil crusts to Ecosystem Processes

Taxon-free detection of cross-scale assembly processes in lichen epiphyte communities

Jes Coyle, UNC-Chapel Hill, @jescoyle



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Which traits?

In which habitats?

Which processes?

At what scales?

Which traits?

Morphological

Growth form

Ramalina capitata

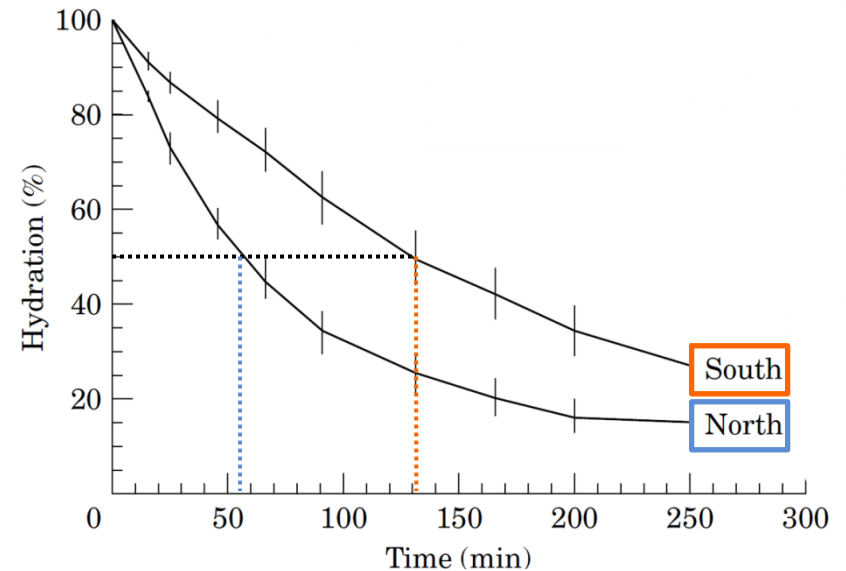


© AJ Silverside

	North	South
Width	4.1	5.7
Length	27.2	18.3
<u>Width</u>	0.15	0.31
<u>Length</u>		

Functional

Rate of evaporative water loss



Pintado et. al 1997

DOI: [10.1006/anbo.1997.0453](https://doi.org/10.1006/anbo.1997.0453)

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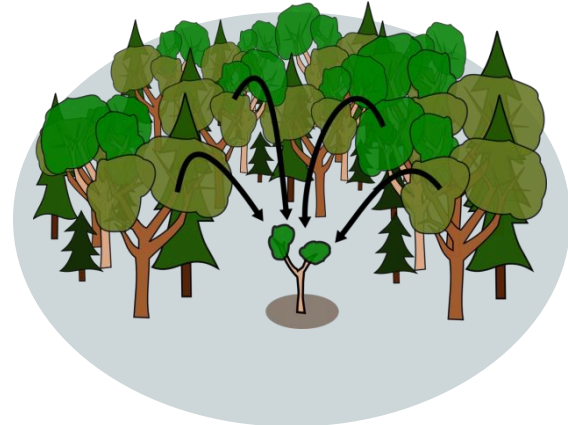
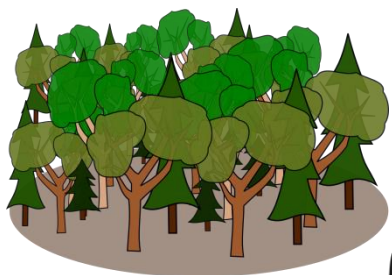
Which traits?

► Morphological

In which habitats?

Which processes?

At what scales?



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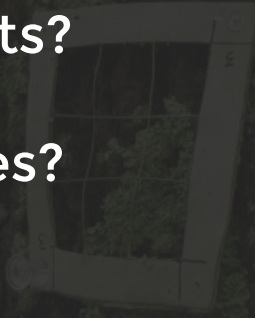
► Morphological

In which habitats?

► Forest epiphytes

Which processes?

At what scales?



Taxon-free detection of cross-scale assembly processes in lichen epiphyte communities ?

Which traits?

▶ Morphological

In which habitats?

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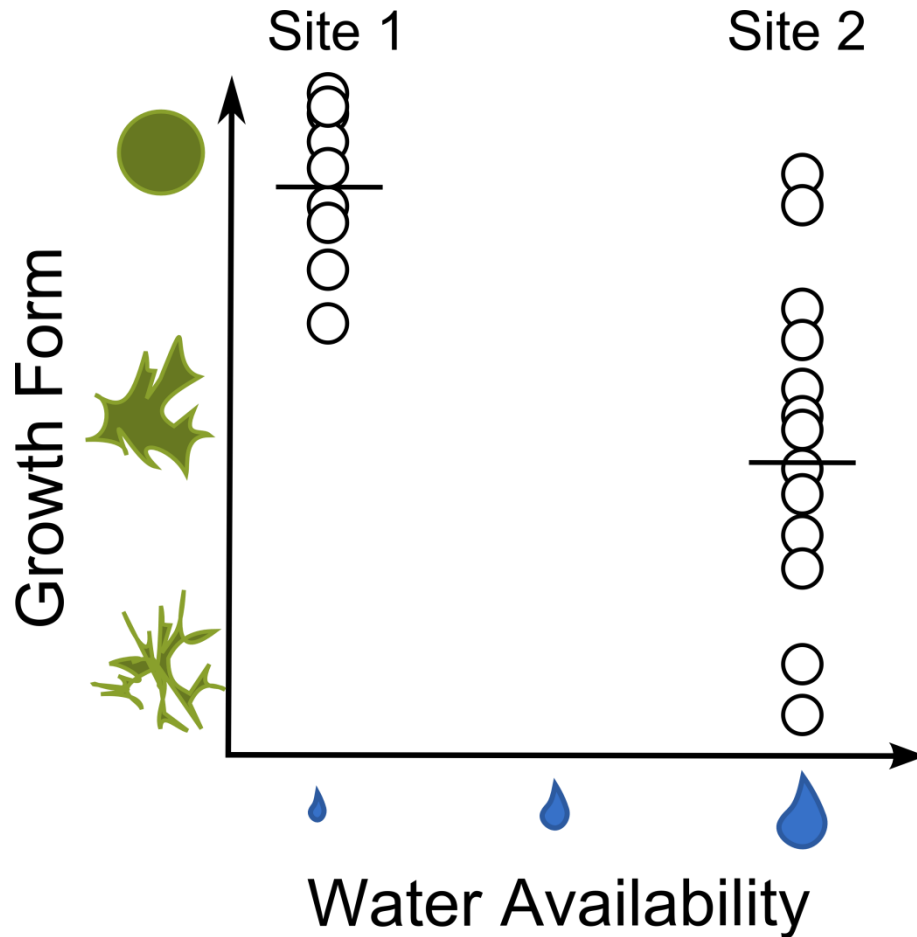
Which processes?

▶ Community assembly

At what scales?

▶ Tree → Region

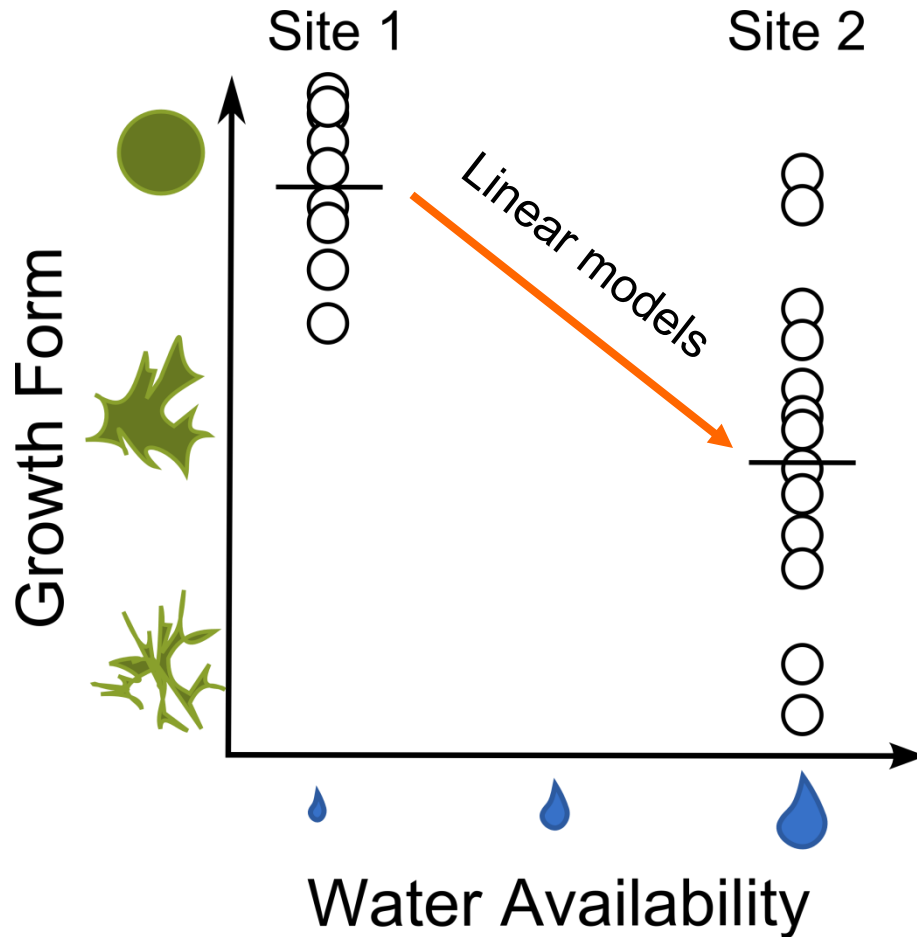
Do traits reveal community assembly processes?



Hypothesis:

Water availability
limits growth of
lichens with finely
dissected lobes.

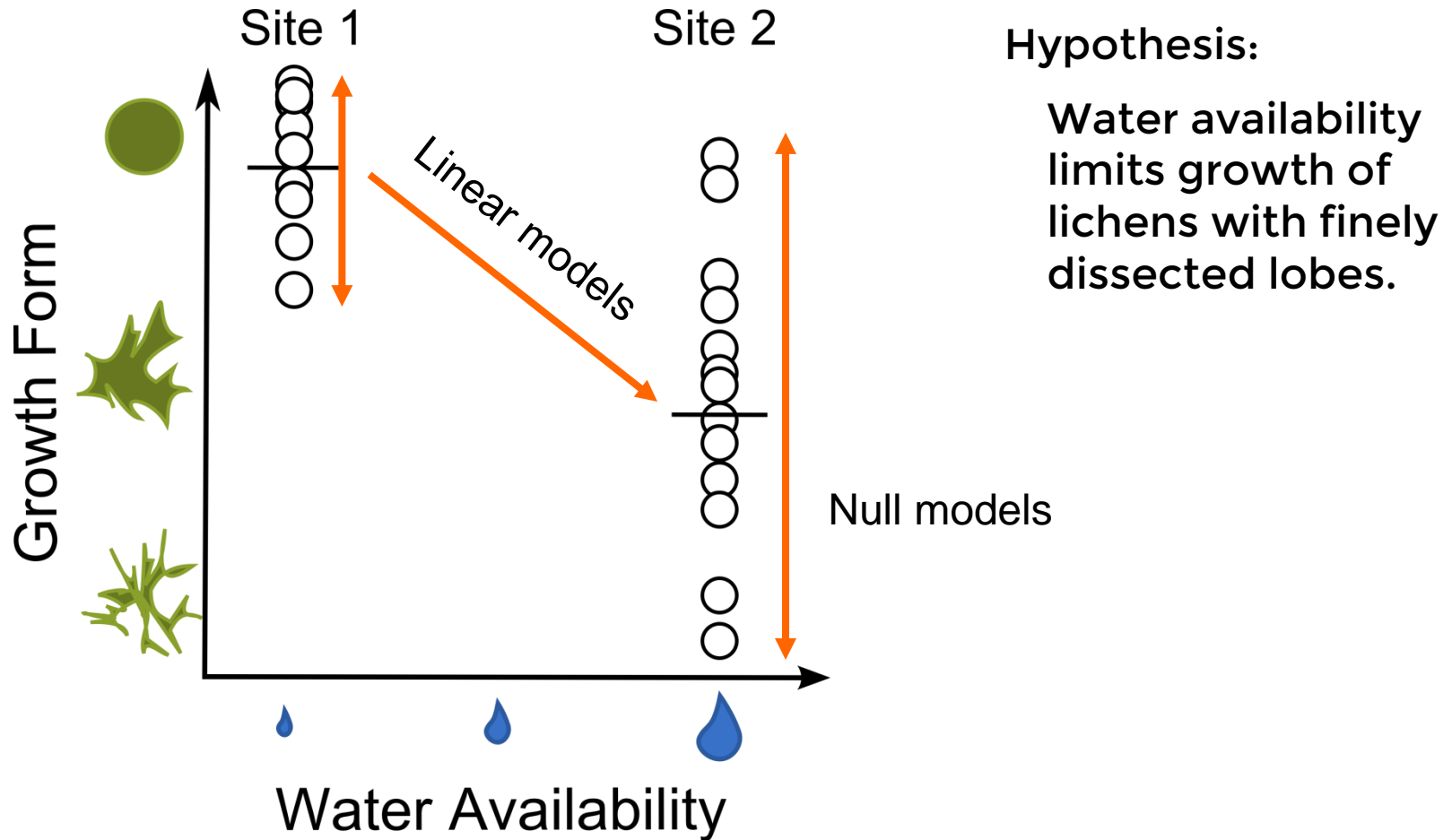
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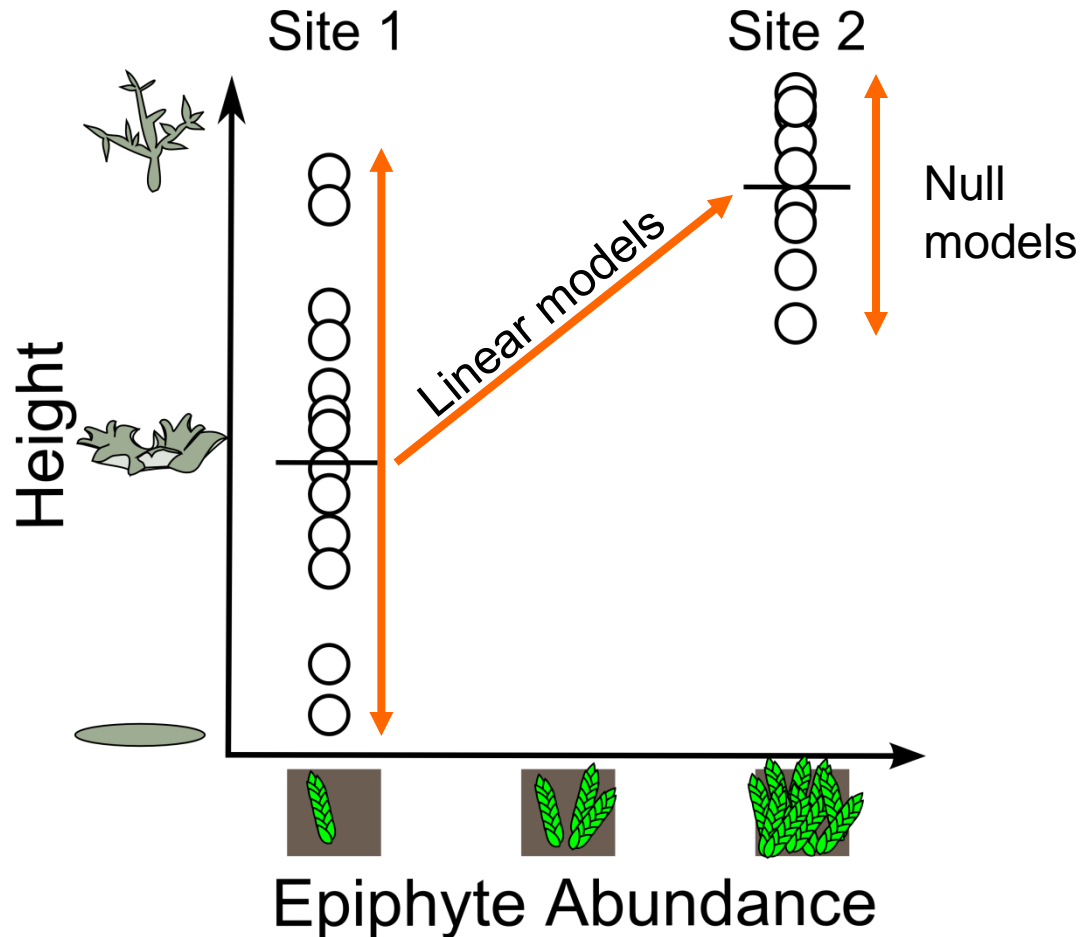
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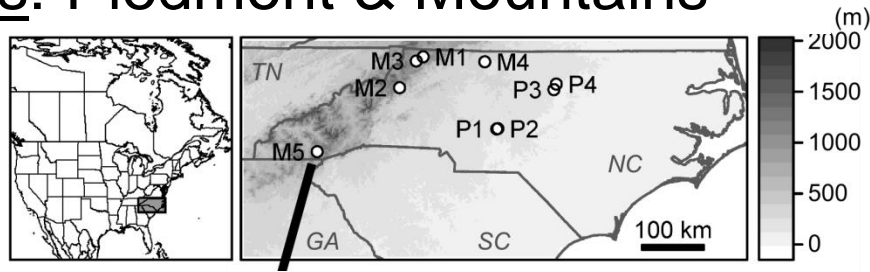


Hypothesis:

Water availability
limits growth of
lichens with finely
dissected lobes.

Competition
favors taller
growth forms.

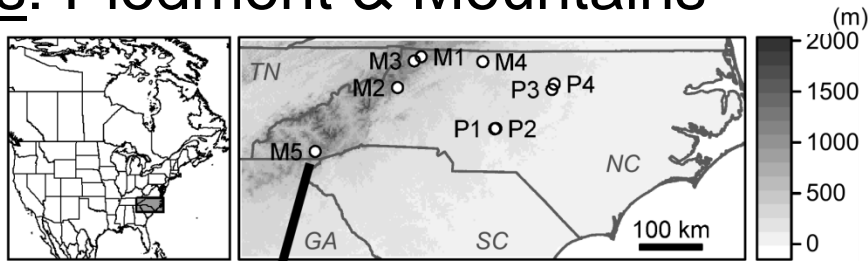
Regions: Piedmont & Mountains



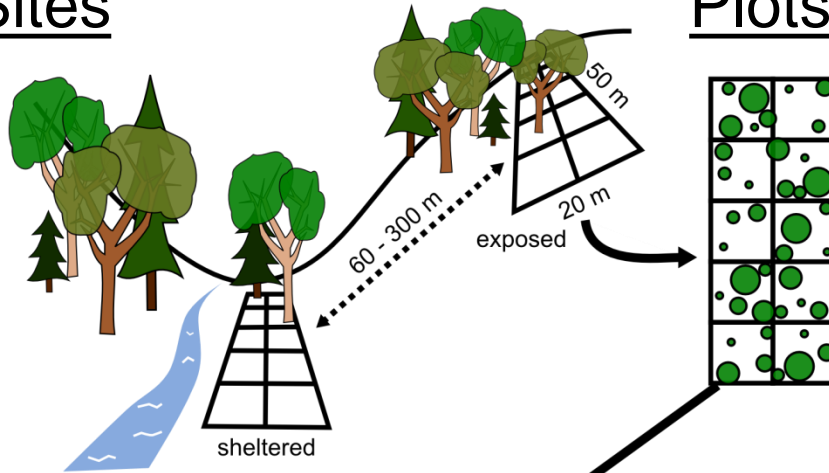
Environment

Climate

Regions: Piedmont & Mountains



Sites

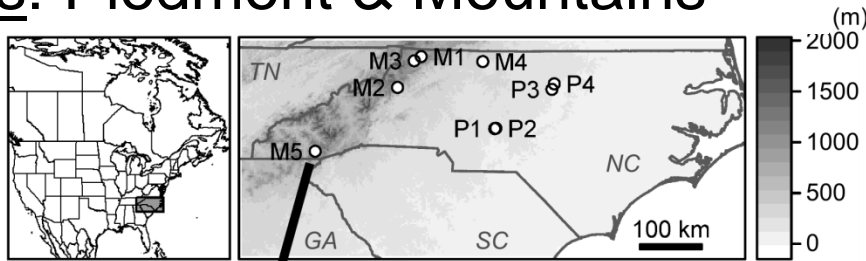


Environment

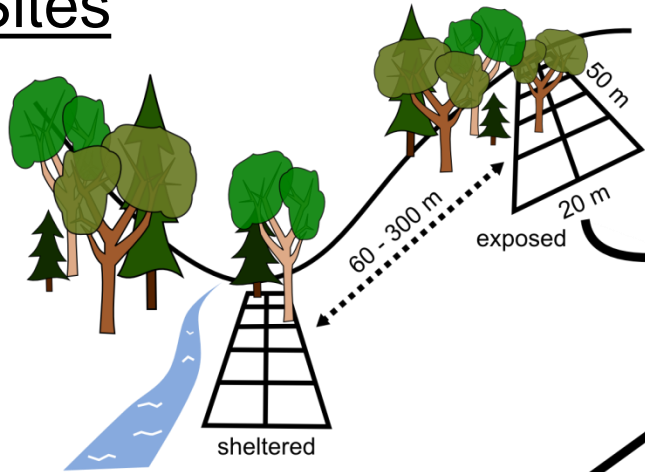
Climate

Exposure
Soils

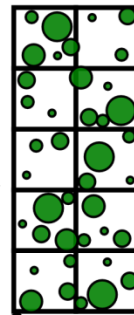
Regions: Piedmont & Mountains



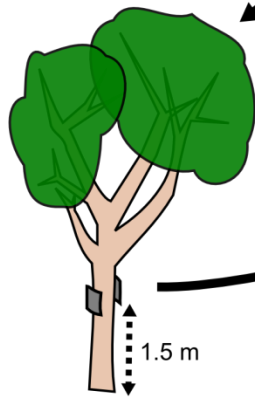
Sites



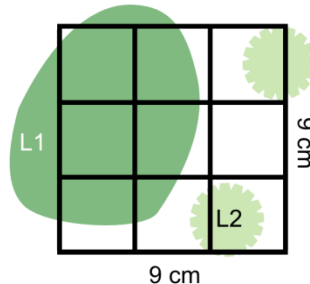
Plots



Trees



Samples

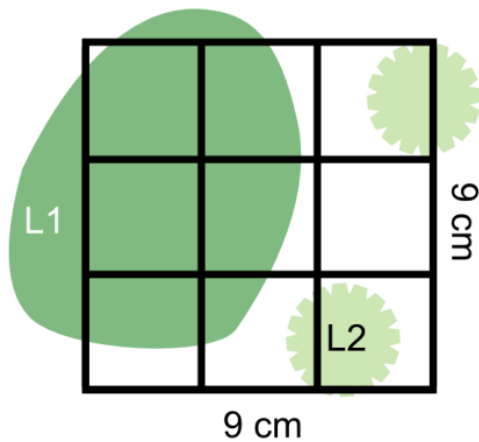


Environment

Climate

Exposure
Soils

Light
Tree size
Bark characteristics



<i>Lichen</i>	<i>Abun.</i>	<i>Traits</i>
<i>Lichen 1</i>	6	...
<i>Lichen 2</i>	3	...

Abundance
Total frequency = 6+3

Photobiont
Growth form
(type, size, shape)
Attachment
Structures
(hairs, pores)
Reproduction
(type, amount)

Traits
Weighted mean
(or proportion)

Acknowledging...



Field Assistants

Holly Pittard

Elias Athey

Jesse Fitzpatrick

Bolu Aluko



Lab Assistants

Sarah Krantz

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Ivy Somocurcio

Brian Sherman

Michael Auriemma



Research Sites

North Carolina State Parks

U.S. Forest Service

Triangle Land Conservancy

Funding

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Are trait patterns consistent with processes?

Process	Hypothesis	Support
Environmental Filtering	<ul style="list-style-type: none">• Traits that increase water retention on drier surfaces and in drier sites• Trait-substrate environment relationships more pronounced in drier sites	
Competition		
Disturbance		
Dispersal Limitation		

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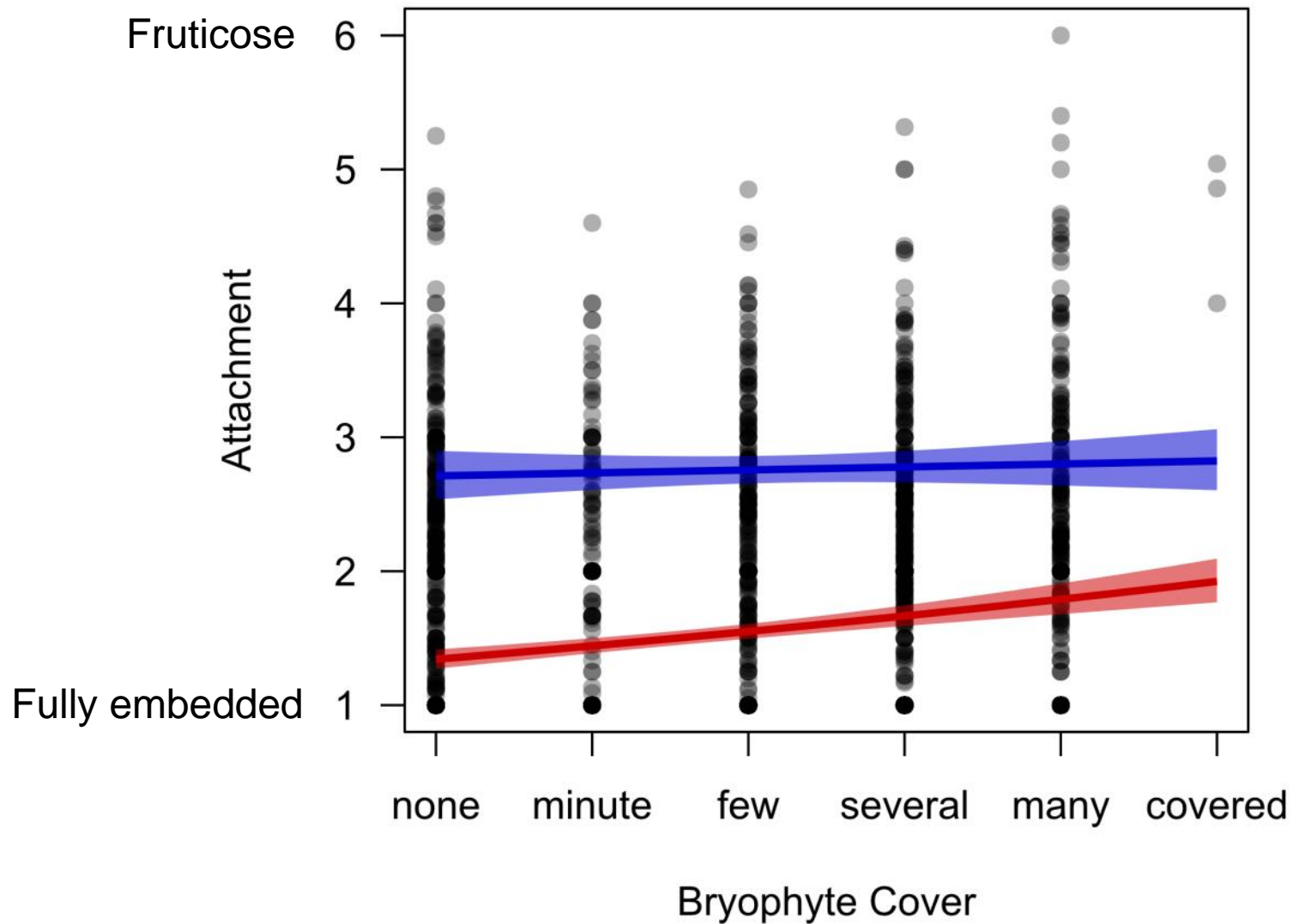
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Environmental or Competitive Filtering?

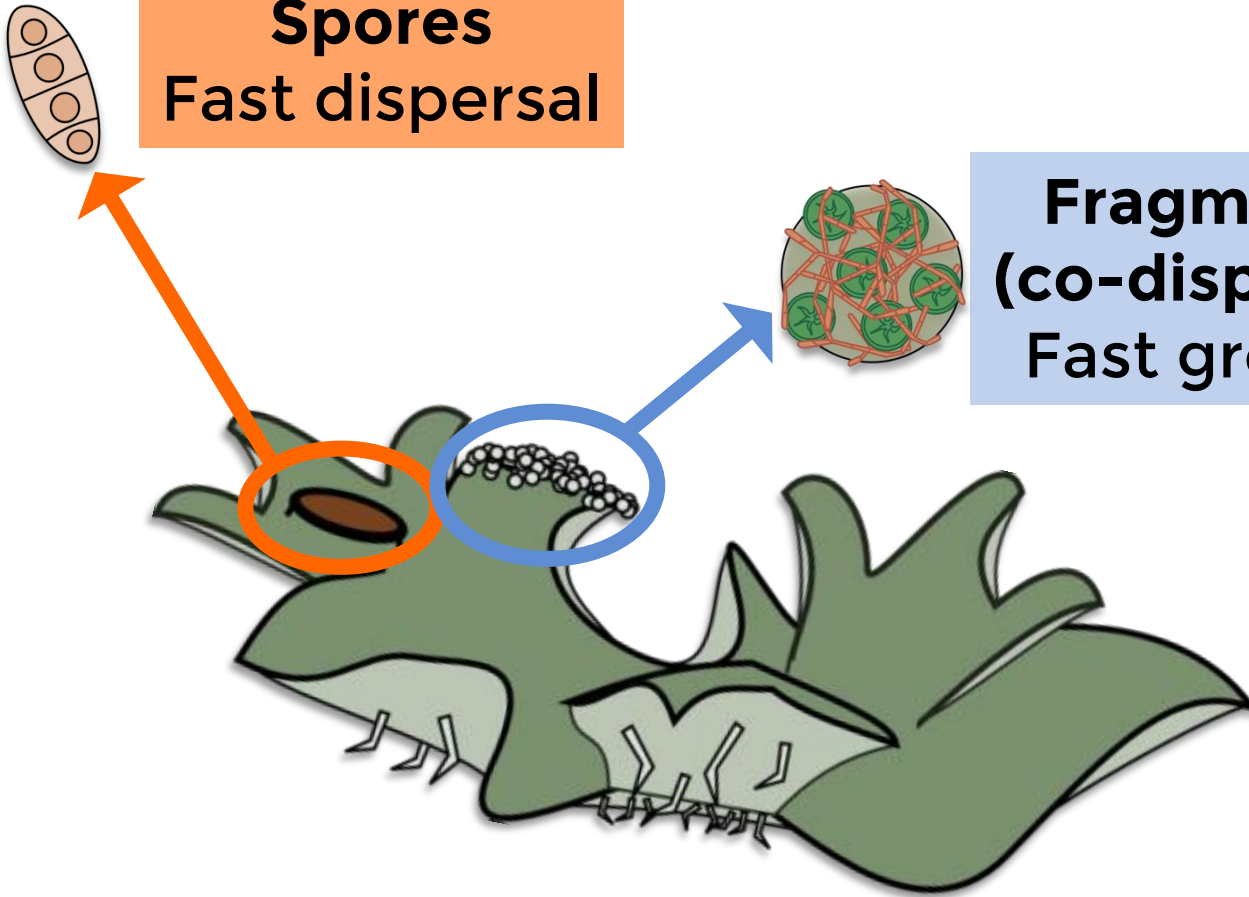


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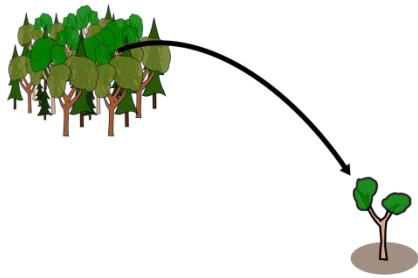
Spores
Fast dispersal

**Fragments
(co-dispersal)**
Fast growth

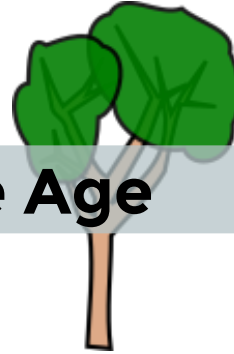
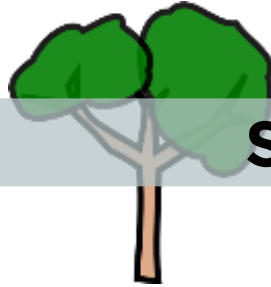


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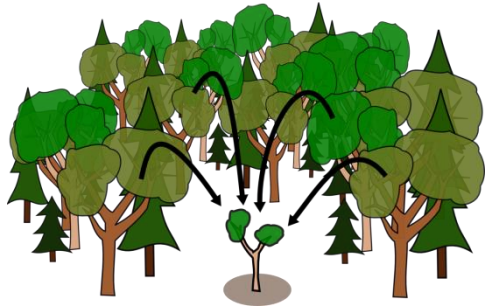
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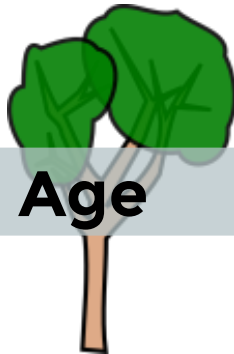
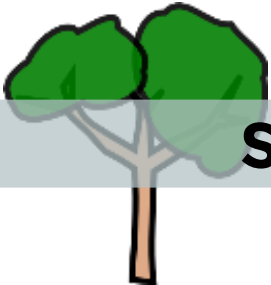
Propagule Limitation



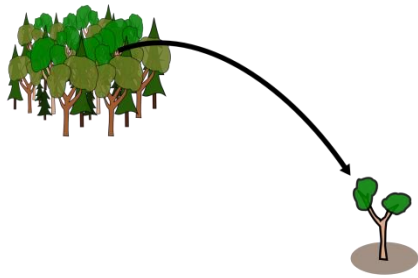
Substrate Age



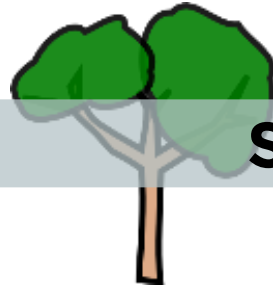
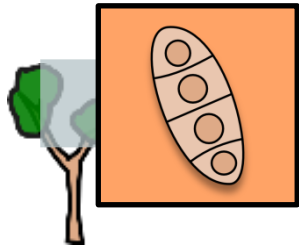
Partner Limitation



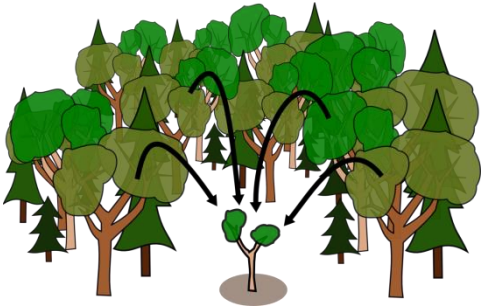
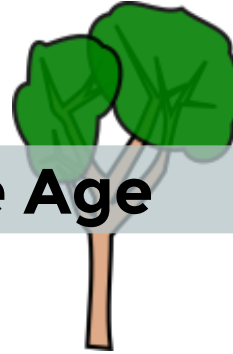
Substrate Age



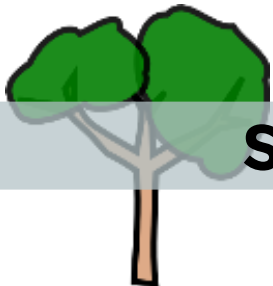
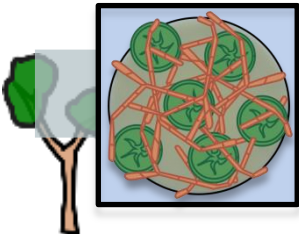
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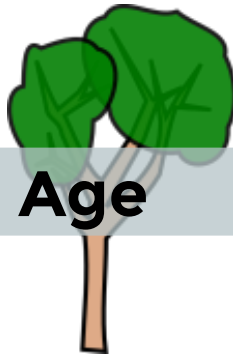
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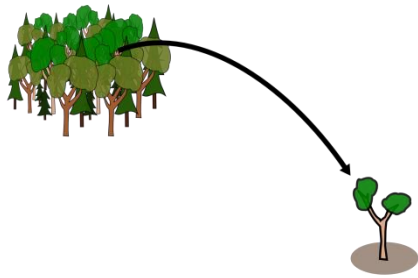


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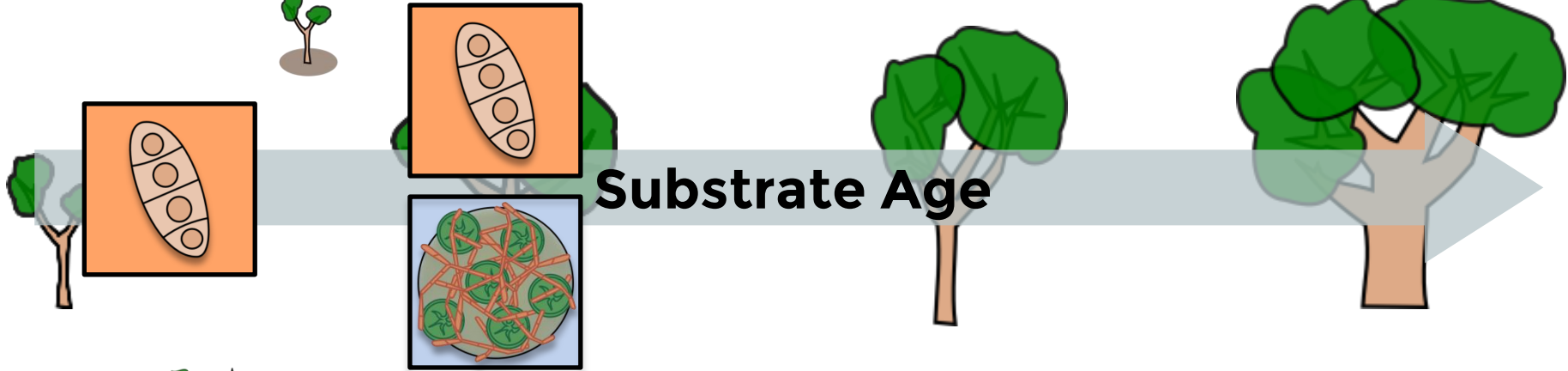


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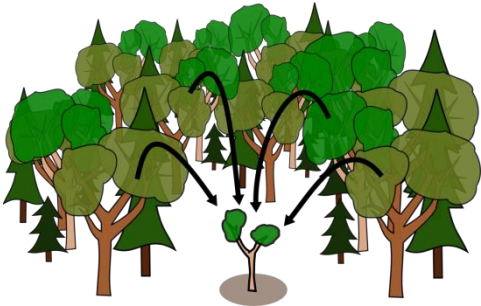




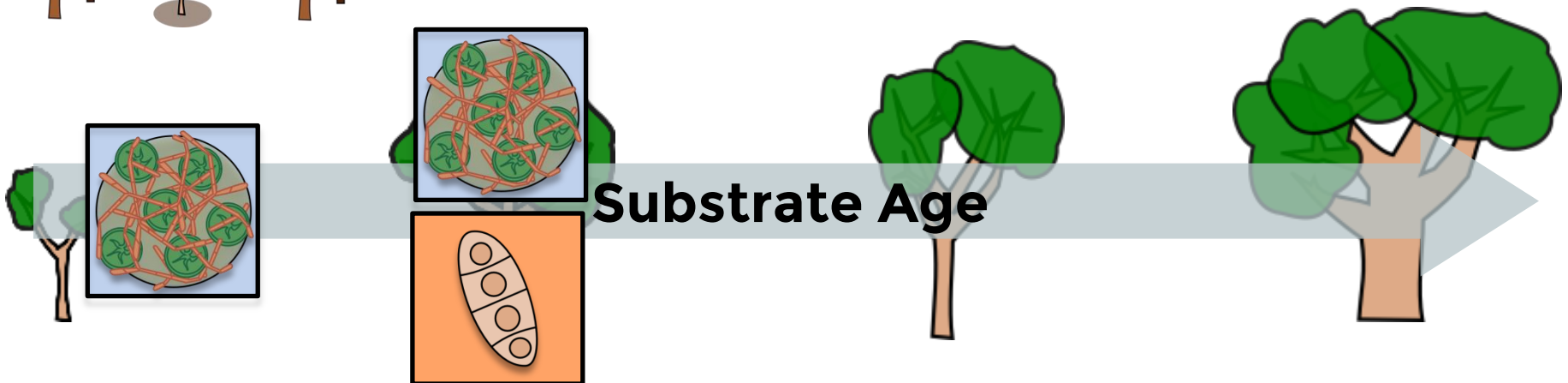
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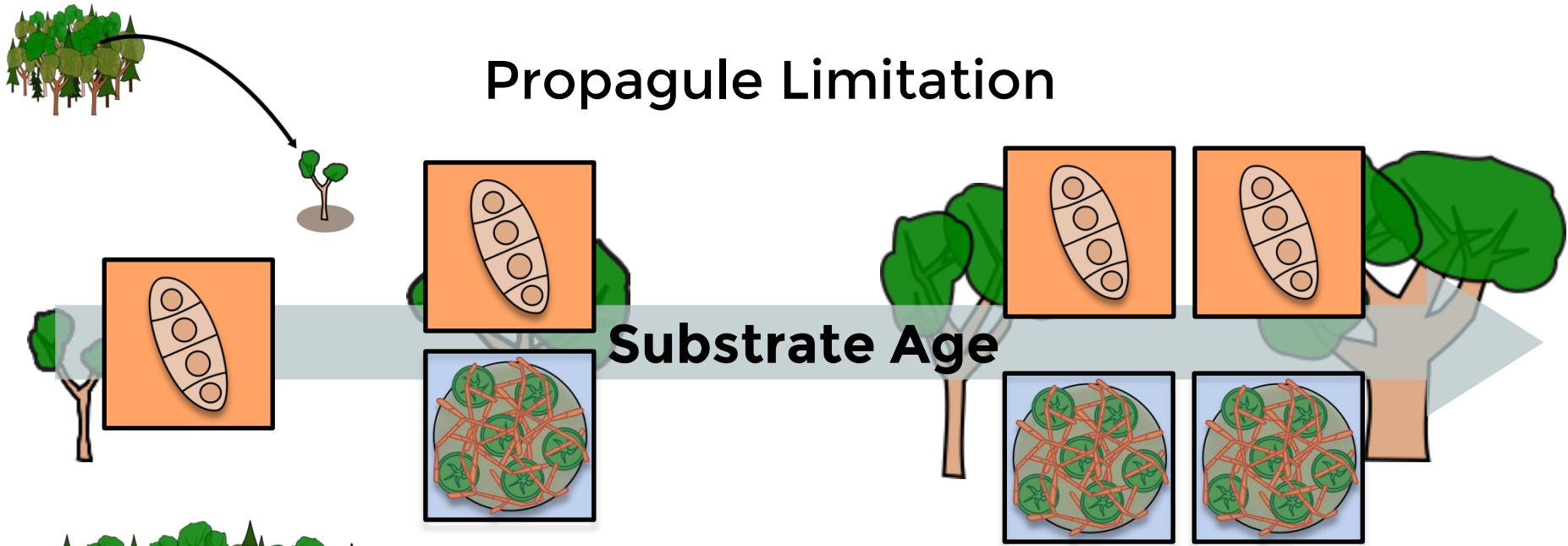


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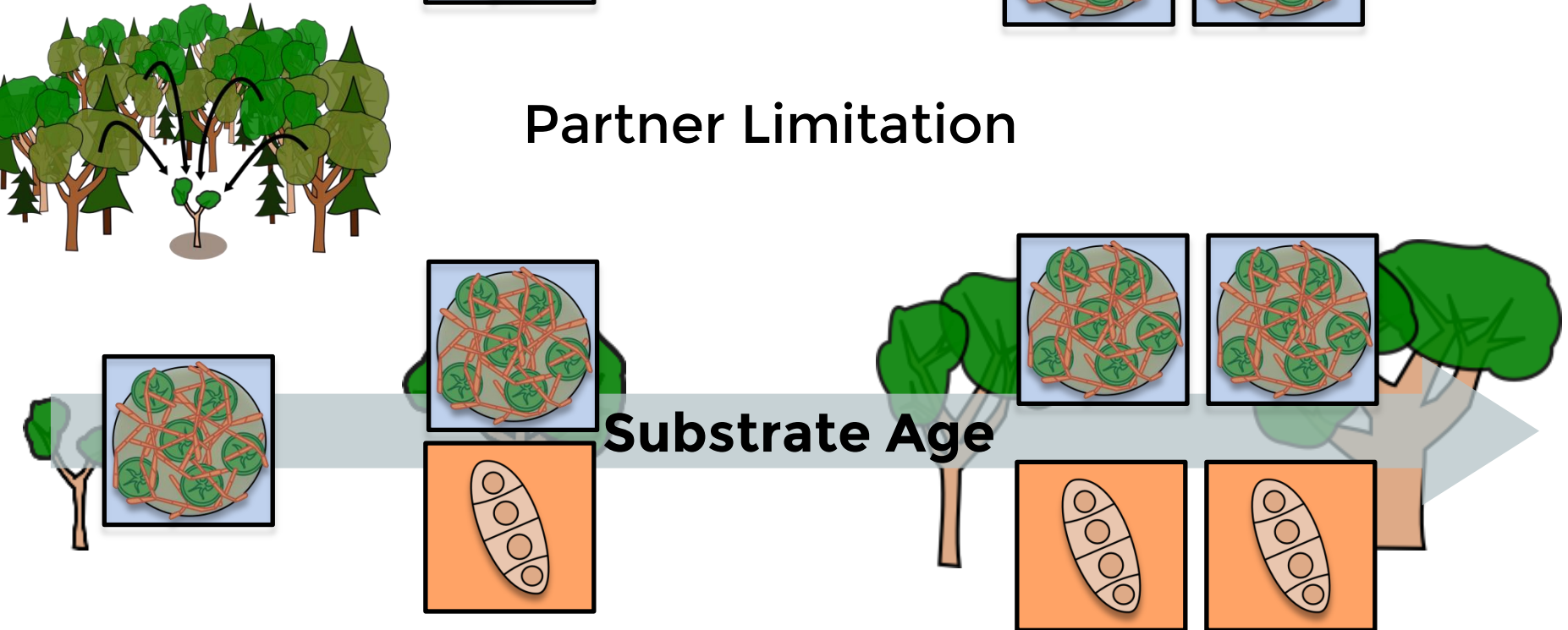


Substrate Age

Propagule Limitation



Partner Limitation

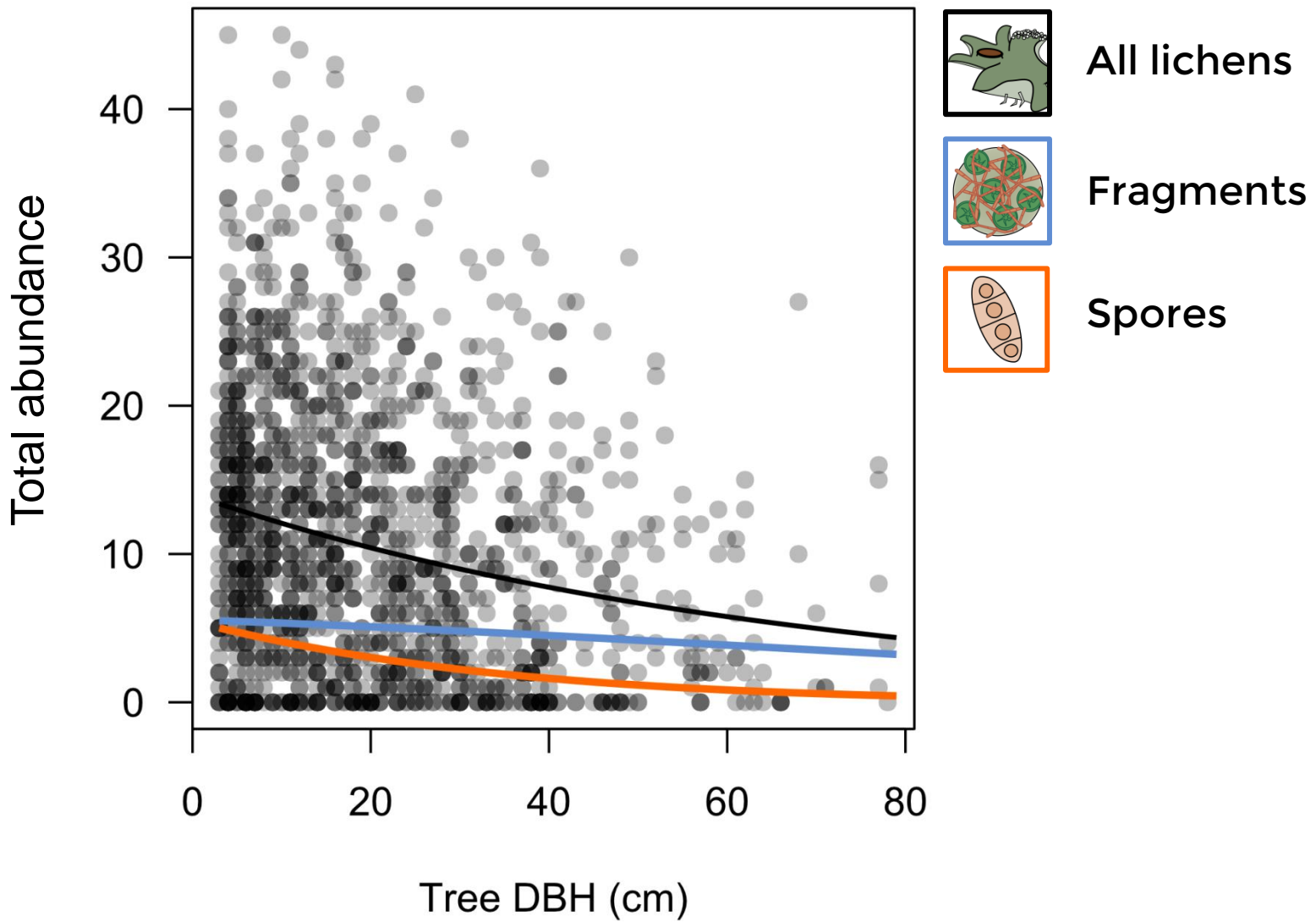


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In which habitats?

Which traits?

Which processes?

At what scales?

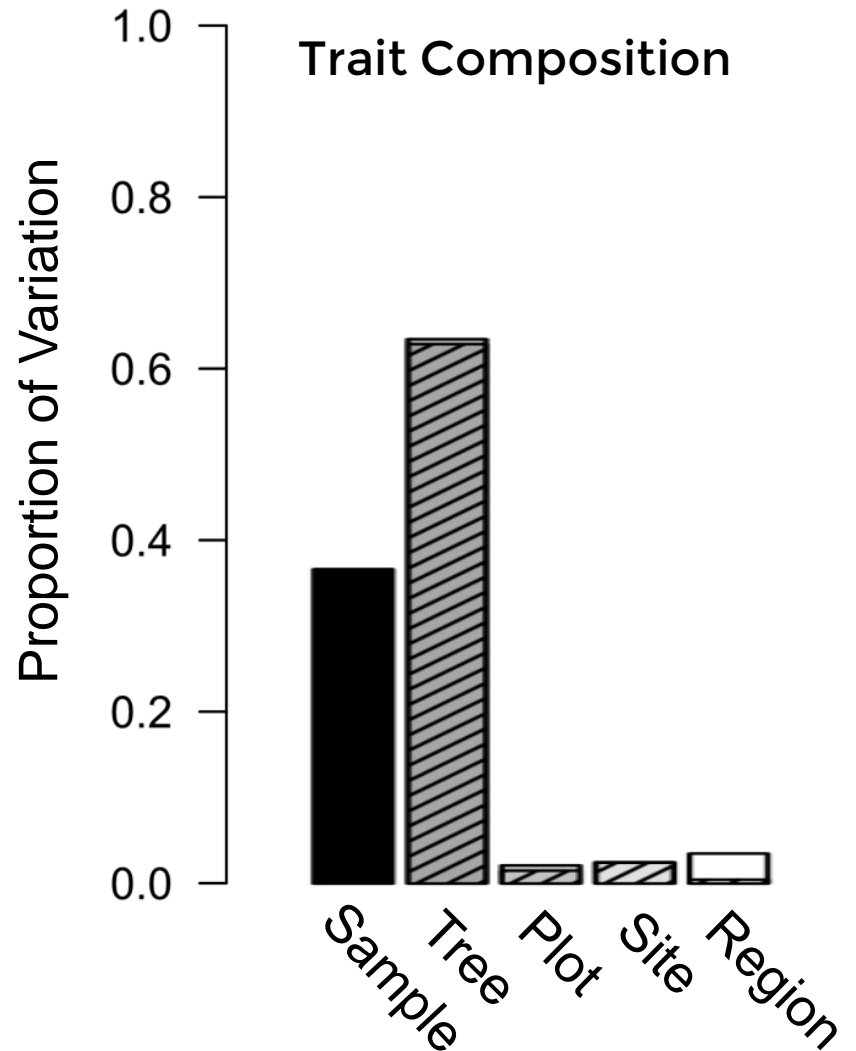
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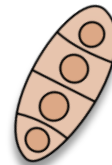
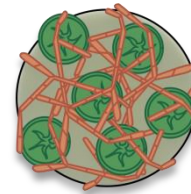
At what scales?



4,740 SPECIES



1 TRAIT





Thank You

Committee

Allen Hurlbert
François Lutzoni
Robert Peet
Charles Mitchell
Joel Kingsolver

Field Assistants

Holly Pittard
Elias Athey
Jesse Fitzpatrick
Bolu Aluko

Lab Assistants

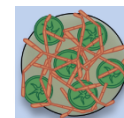
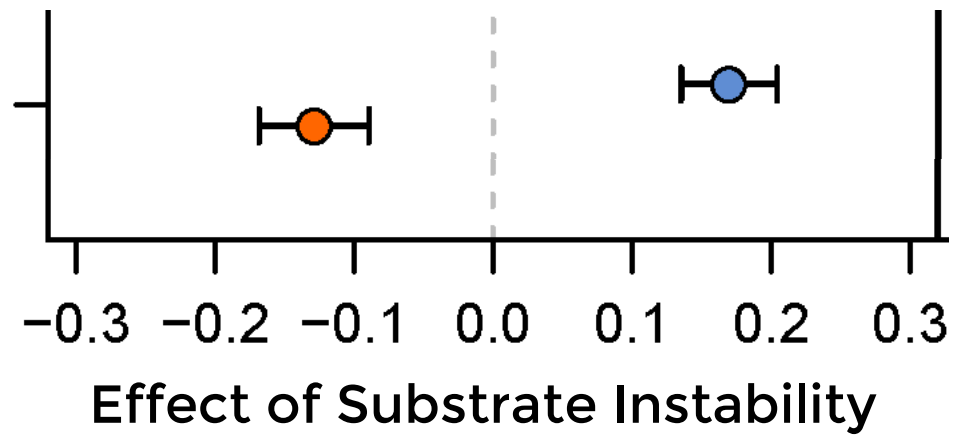
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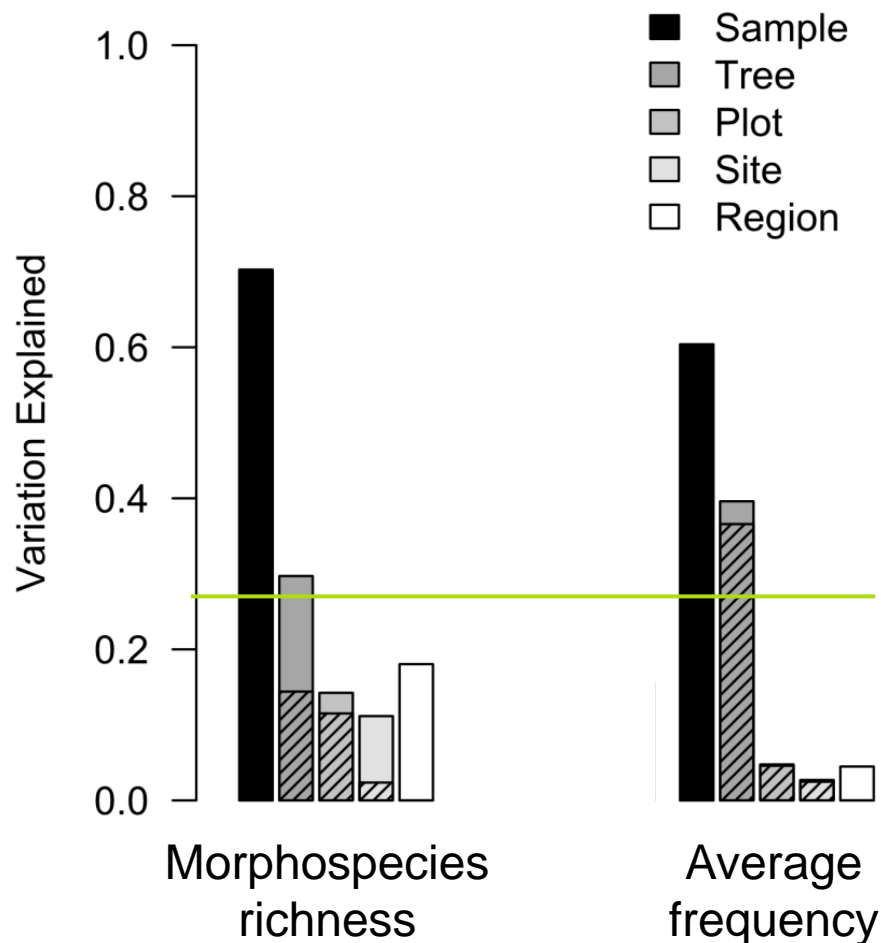


Fragments



Spores

How do communities vary across scales?



Proportion of Variance

Trait	Tree	Plot	Site	Ecoregion
Prop. crustose	0.001	0.008	0.002	0.007
Prop. foliose	0.135	0.067	0.026	0.032
Prop. fruticose	0.080	0.008	0.002	-
Attachment	0.521	0.117	0.084	0.418
Lobe area	0.265	0.152	0.077	0.132
Lobe dissection	0.124	0.023	0.034	0.062
Prop. cilia	0.217	0.074	0.035	-
Prop. sexual	0.165	0.016	0.028	0.034
Prop. asexual	0.088	0.013	0.021	0.025
Sexual effort	0.303	0.009	0.091	0.032
Asexual effort	0.441	0.072	0.045	0.018