

Within-Species Variation in Allocation and Tissue Traits Across Large Aridity Gradients

Leander DL Anderegg^{1,2} Ian Markham³, Xingwen Loy⁴, Christina Elmer⁵, Mark Hovenden⁶, Janneke HilleRisLambers¹, Margie Mayfield⁵

¹U of Washington ²UC Berkeley ³Wild Hope ⁴Emory University ⁵U of Queensland ⁶U of Tasmania
email: l.anderegg@berkeley.edu twitter: @leanderegg website: ldlanderegg.weebly.com

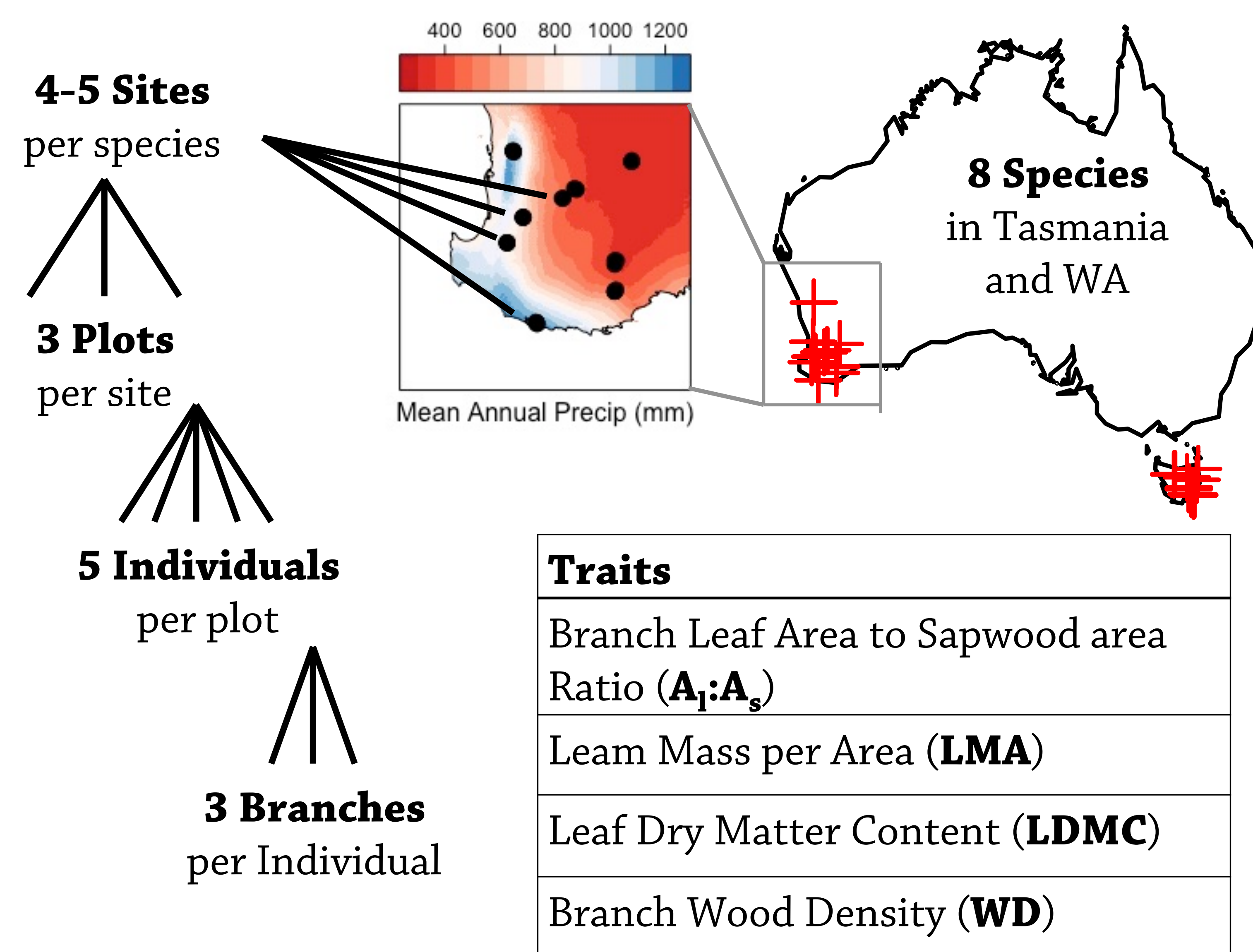
Background

Tissue densities and allocation to leaf vs stem tissue are important parameters for Earth System Models and carbon inventory estimates, yet their variation with climate and covariation with each other are poorly understood within individual species. We quantified within-species variation in leaf and branch traits across the aridity range of 7 related Eucalypt tree species and an Acacia species to

1. Test for common trait-environment relationship in a variety of climatic conditions
2. Test the coordination between tissue robustness and branch allometry within species
3. Examine whether total trait variation is more constrained in drier sites and more drought adapted species.

Methods

Nested sampling of leaf and branch traits (1620 total branches)



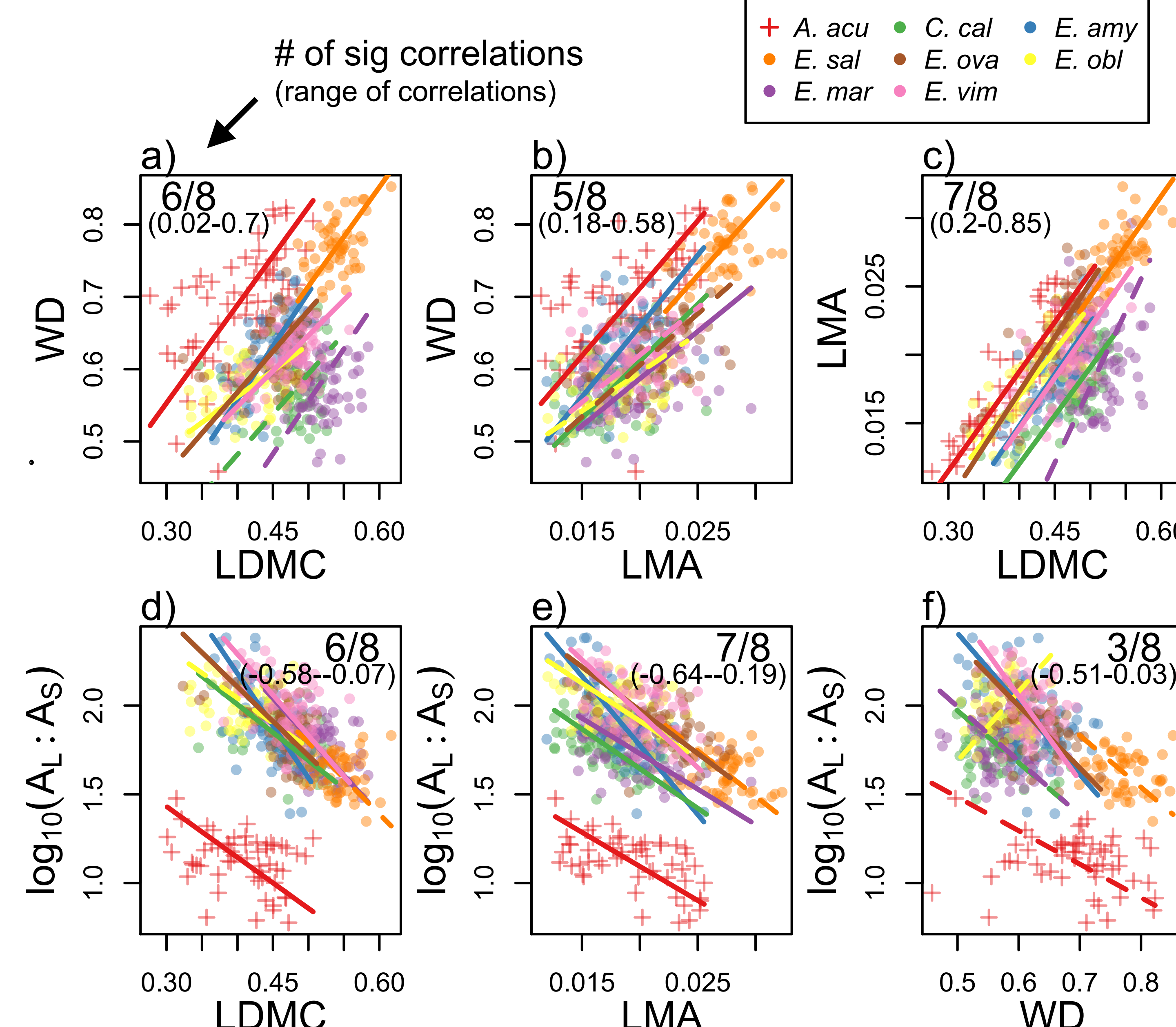
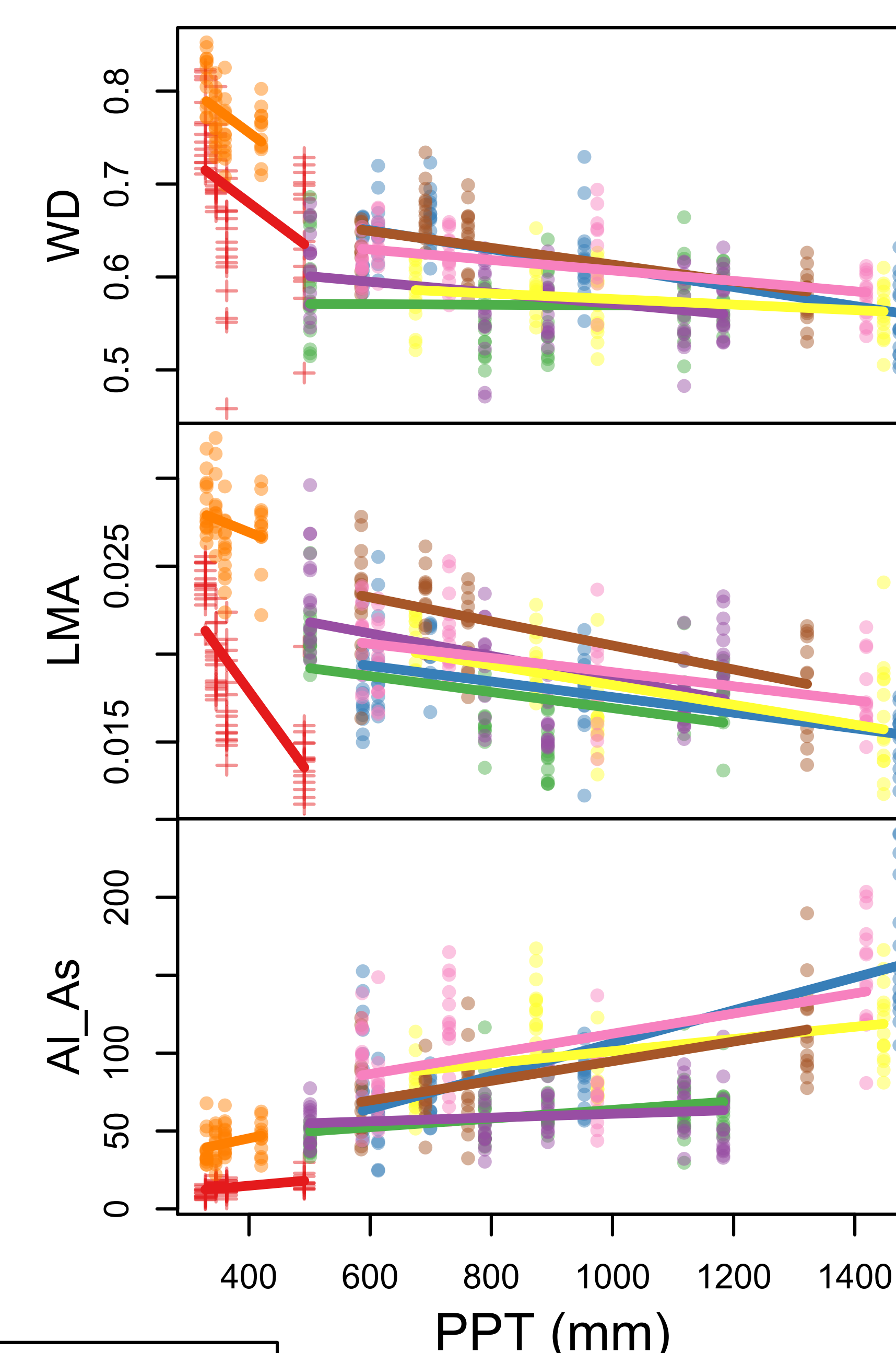
Results

1. Consistent trait responses to aridity

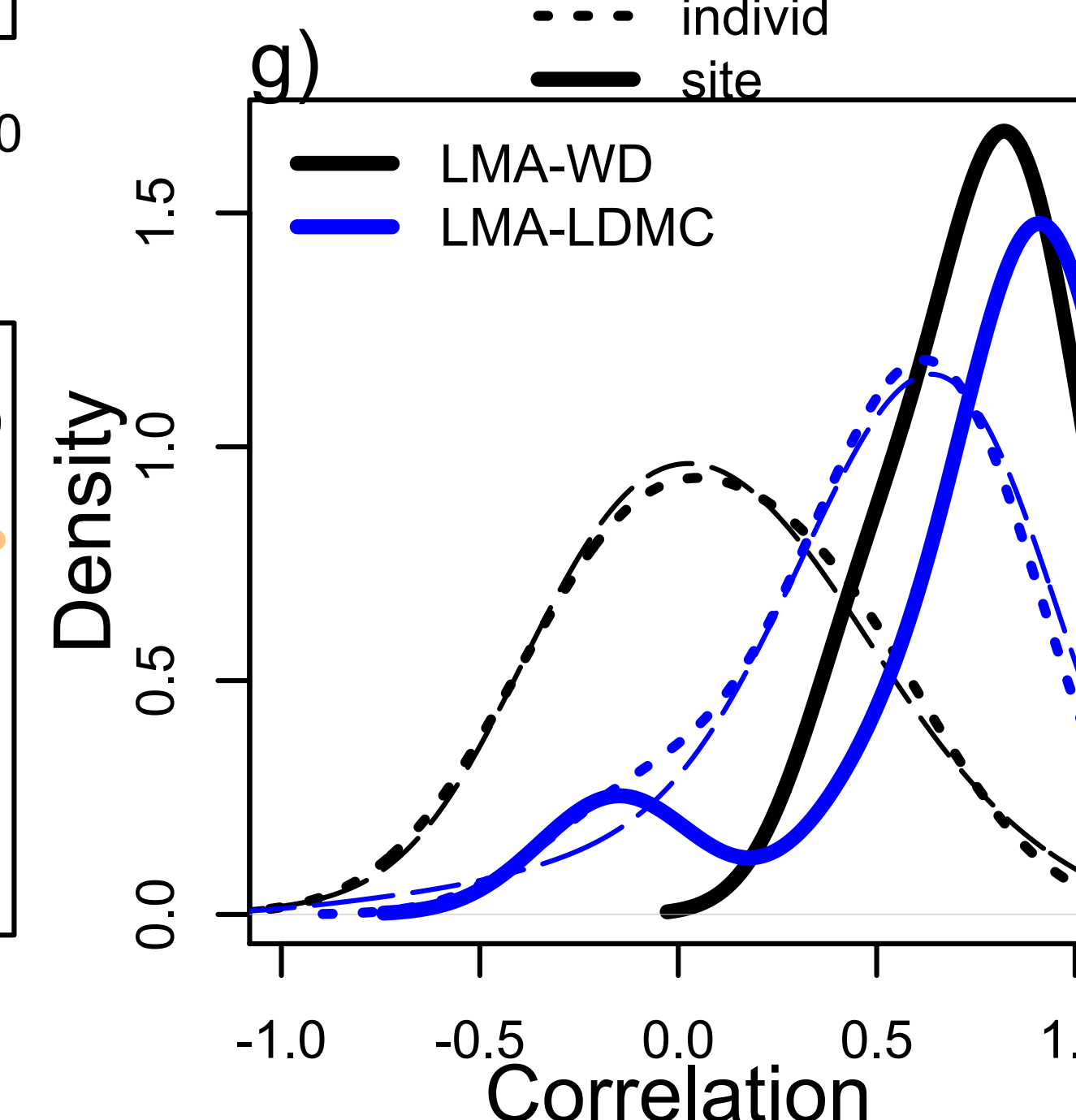
Almost all species showed trait-environment relationships with aridity (PPT, PET, Moisture Deficit) for all traits (30/32 relationships are significant)

2. Consistent trait integration, but only at large scales

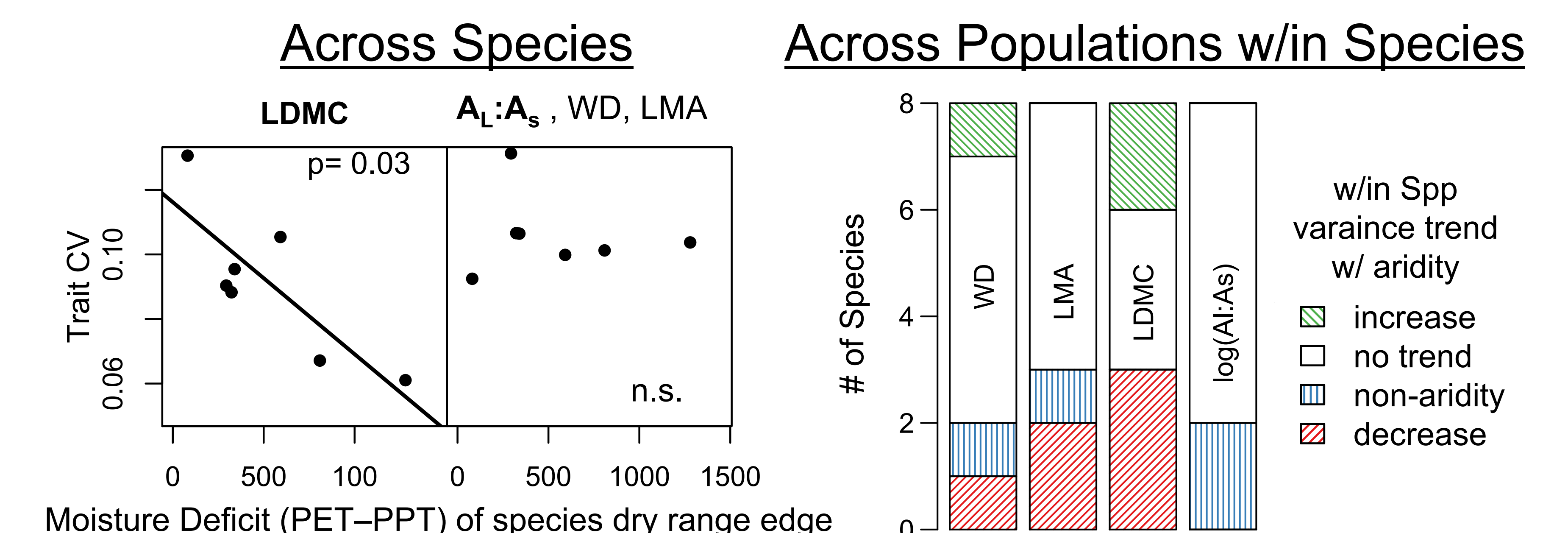
2a - Trait covariation suggested that shifts in allocation were coordinated with increased tissue robustness of leaves and stems (a-f)



2b - Coordination only emerged across climatically disparate sites (g)



3. Across species, trait variation decreased at high aridity for 1 of 4 traits. Across populations, few traits showed decreased trait variation. Even though mean tissue robustness increases and mean allocation to leaves decreases, trait variation does not decrease with aridity as predicted by the classic 'environmental filter' analogy.



Implications

- Consistent within-species adjustments to aridity found when:
 - 1) Looking at closely related species
 - 2) Examining entire species' ranges
 - 3) Crossing precipitation gradients not confounded by cold stress gradients
- Weak trait integration across tissues suggests only indirect links between mechanisms of trait variation
- Trait variances harder to explain than trait means (even in related species) meaning considerably more work is necessary before we can parameterize within-species trait distributions rather than means.

Acknowledgements: Chuck Price for lending us lab space, and to HR Lai, J Park, E Sohlberg, and H Wauchope for field and lab assistance. LDLA funded by: NOAA Climate and Global Change Fellowship, NSF DBI-1711243, National Geographic Society Young Explore Grant