Does intraspecific trait variation contribute to plant community resistance to warming in high Arctic island ecosystems?

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Observations

- ✓ Small changes in temperature constitute a greater relative change in the thermal balance for plants in the high Arctic than the low Arctic
  - ✓ High Arctic plants expected to respond one way or another more strongly to warming
- ✓ Opposite to expectations plant communities respond more strongly to temperature increase in terms of species composition (taxomomic space) in the low Arctic than the high Arctic (e.g. Elmendorf et al. 2012)
  - ✓ Attributed to small species pools, migration barriers – particularly in island ecosystems - and extreme plant longevity

Observations

- ✓ Globally**, intraspecific plant functional trait variation (ITV)** increases with decreasing species richness (Siefert et al. 2015)
- ✓ In regions of small species pools, high intraspecific trait variation may potentially enable plant communities to respond to warming in functional space without any significant change in taxonomic space

Assessing community changes - two approaches

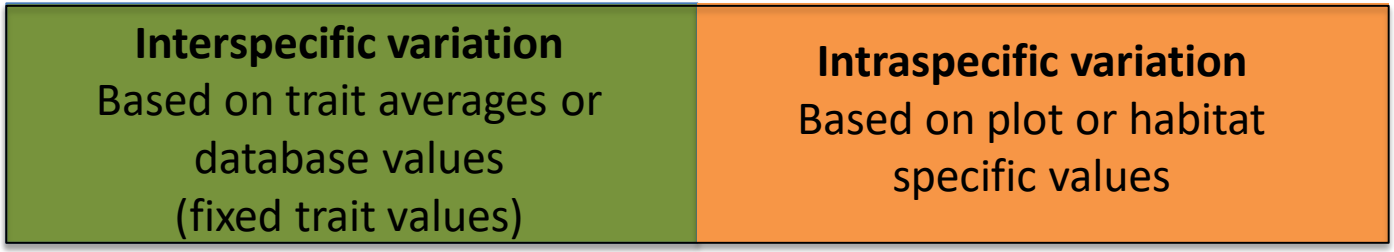
Taxonomic space – Traditional community composition analysis

- ✓ Species abundance
- ✓ Species richness, diversity and evenness

Has limited predictability for ecosystem responses
Westoby and Wright 2006

Functional space

- ✓ Functional traits – community weighted values
- ✓ Can be partitioned between:



Reflects species turnover

Reflects phenotypic plasticity, genetic differentiation

Hypothesis

High Arctic island plant communities respond to warming in a functional space where intraspecific trait variation accounts for a large proportion of the total variation, thus contributing to the observed slow community change in taxonomic space

Conclusions

- ✓ High Arctic plant communities are strongly differentiated among habitats along snow and moisture gradients
- ✓ They respond slowly to warming both in terms of change in species composition (taxonomic space) and plant functional traits (functional space)
  - ✓ Unexpectedly, plant communities in dry habitats responded more strongly to warming than in moist habitats in both taxonomic and functional space
- ✓ Even though the overall functional trait responses to warming are slow, they are mainly due to intraspecific variation
- ✓ High Arctic plants appear to be extremely tolerant (and therefore resistant) to climate warming

Endalen, Svalbard – 15 years of warming - three habitats

Snowbed – moist - deep snow in winter (100-200 cm)

Cassiope heath – mesic - intermediate snow depth (30-50 cm)

Dryas heath – dry - shallow snow in winter (10-20 cm)

BIS

Bistrota vivipara

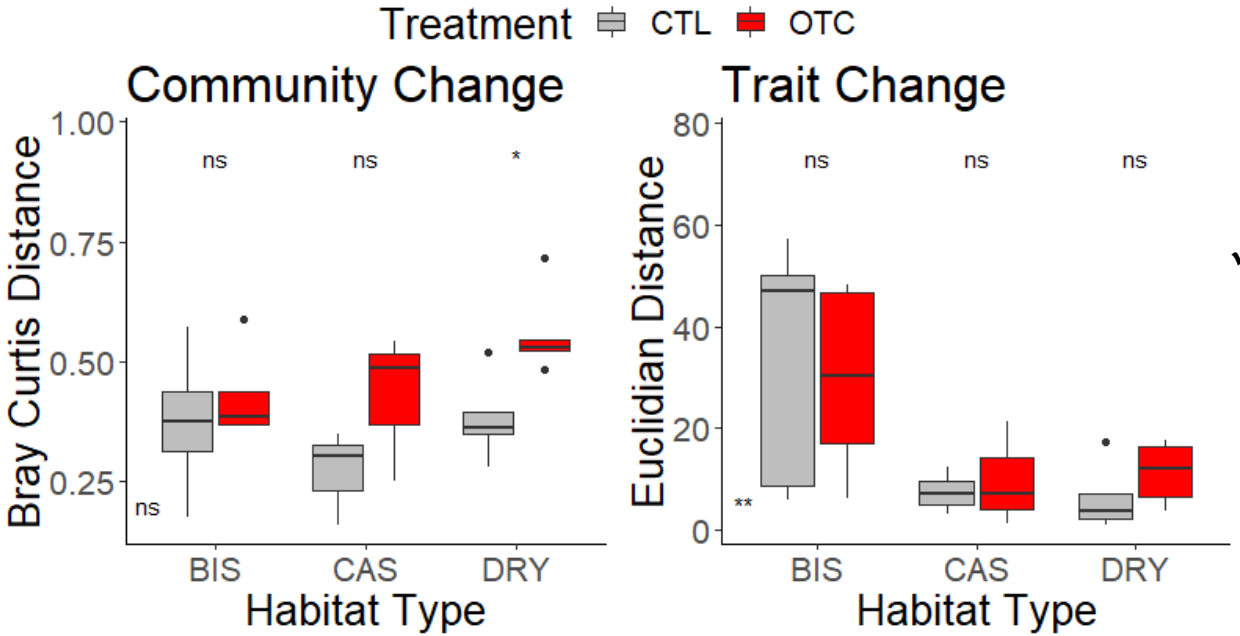
CAS

Cassiope tetragona

DRY

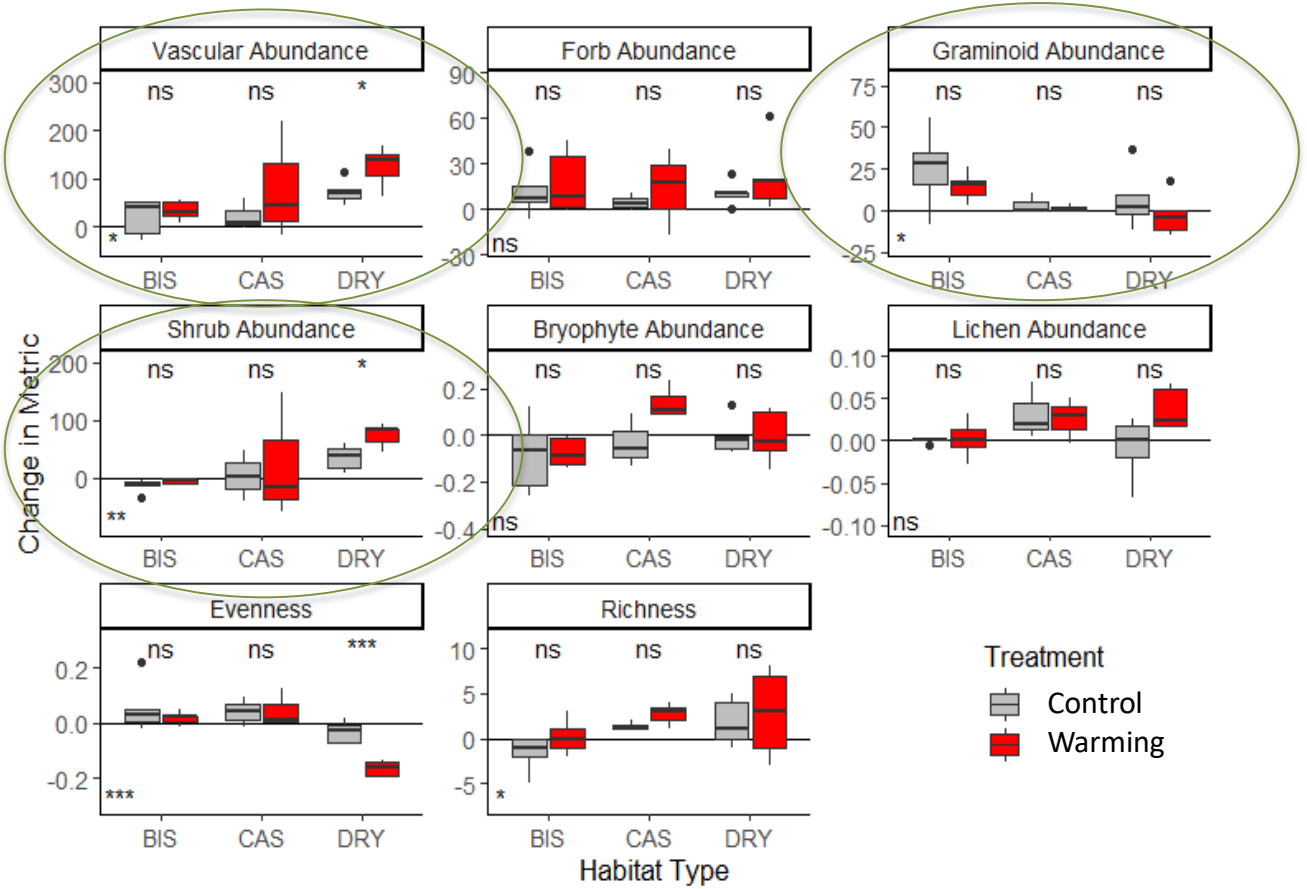
Dryas octopetala

Overall community and trait change in multivariate space over 15 years



- ✓ The *Dryas*-heath had responded most to warming in taxonomic space
- ✓ The snowbed community (BIS) had changed most overall in functional space

Treatment effects on plant abundance and diversity



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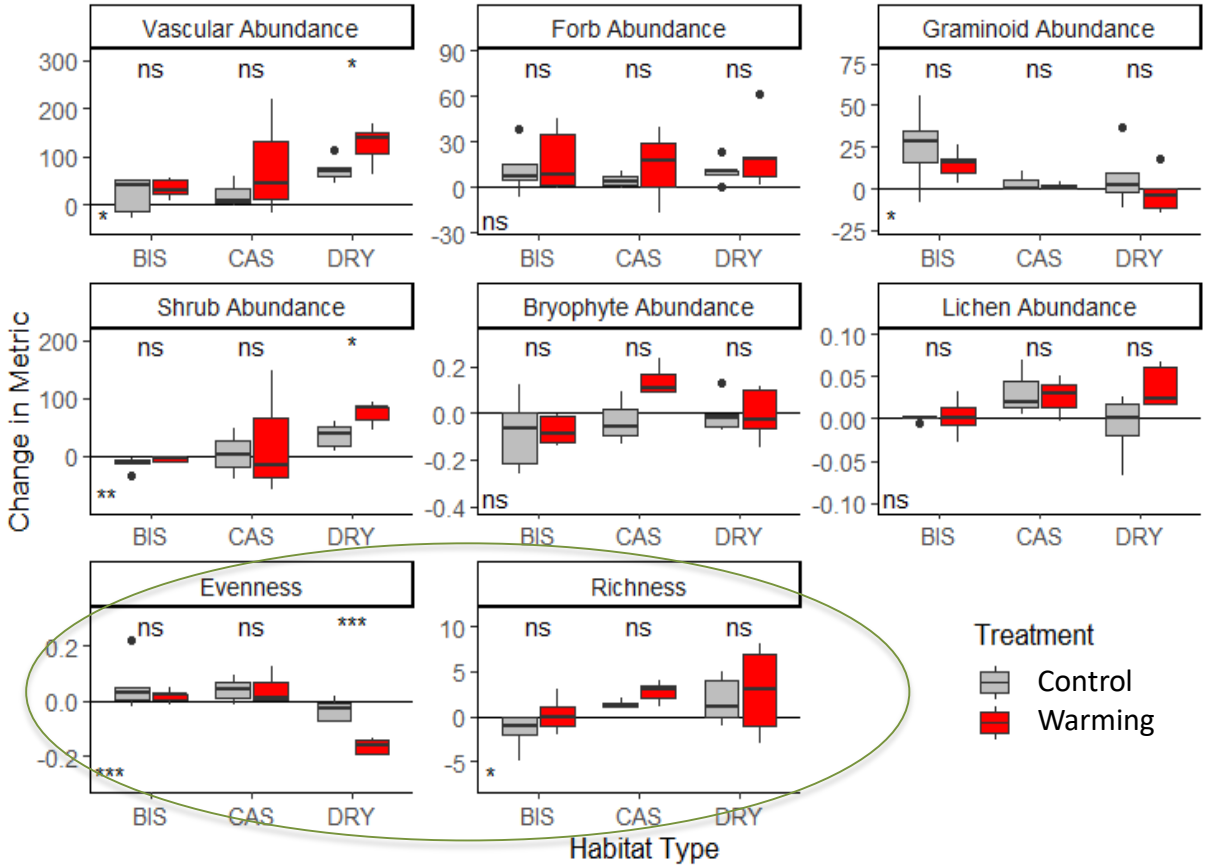

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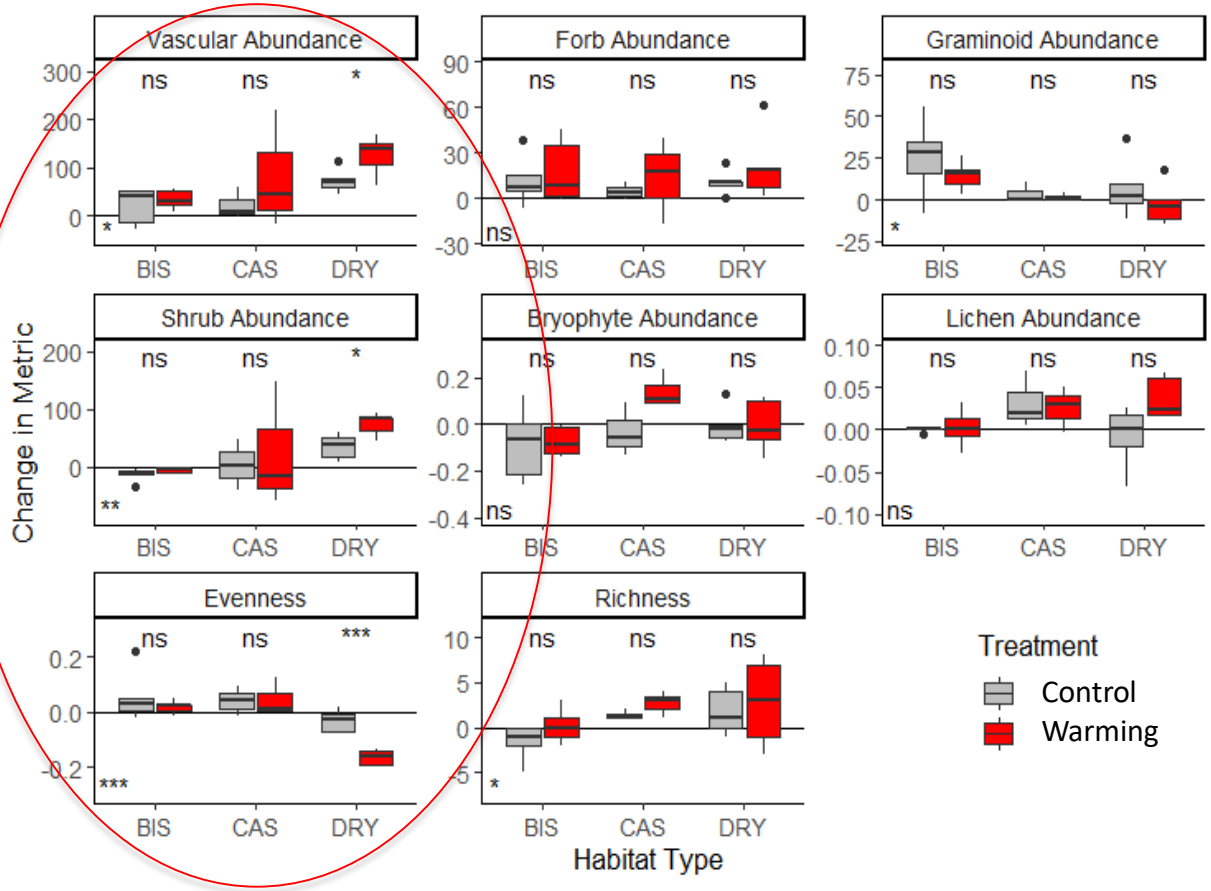
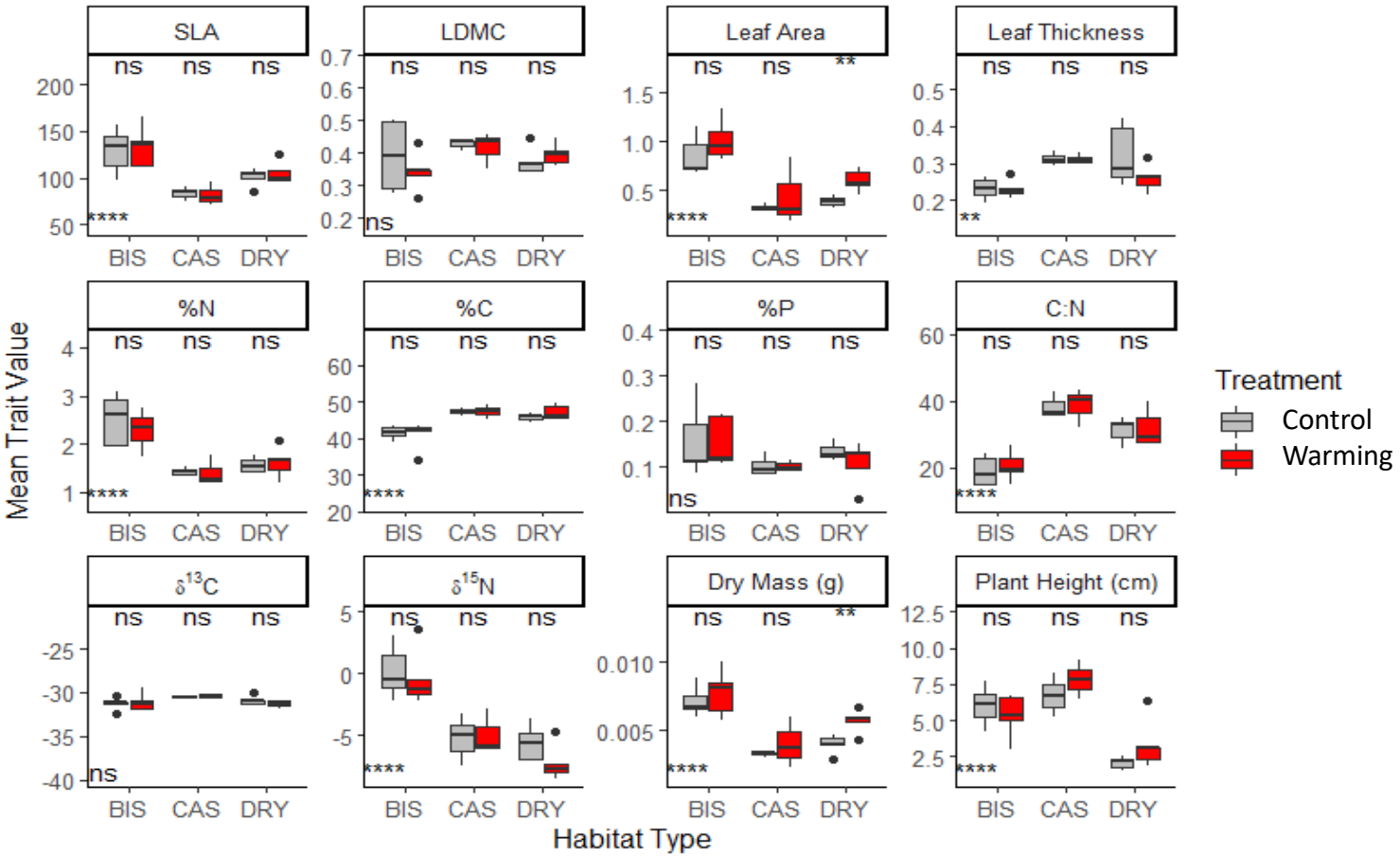


- ✓ Total vascular plant abundance and shrub abundance increased by warming, but only in *Dryas* heath
- ✓ Evenness decreased by warming, but only in *Dryas* heath

Treatment effects on 12 plant traits

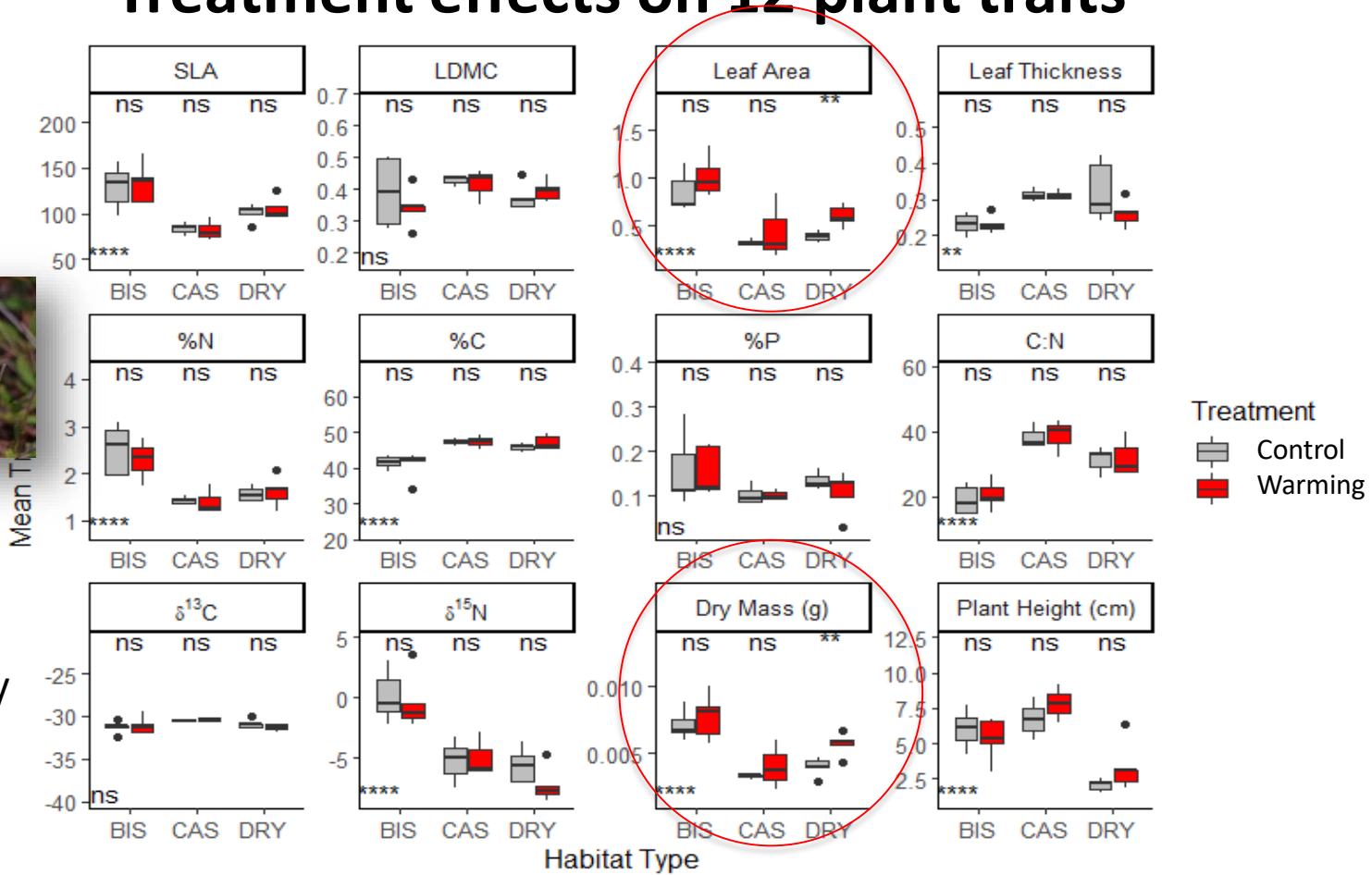
- ✓ Most traits (10 of 12) differed between habitats



Treatment effects on 12 plant traits

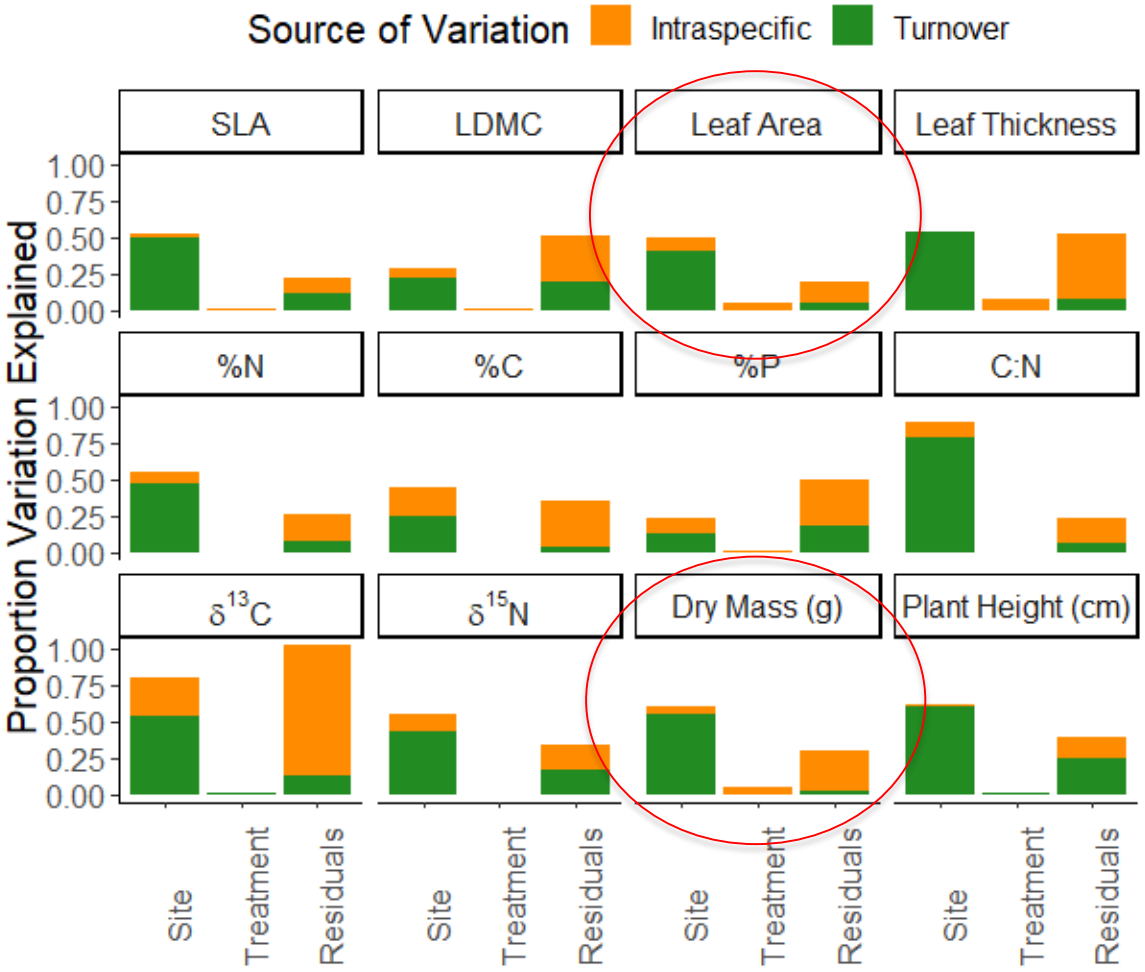
- ✓ Most traits (10 of 12) differed between habitats

- ✓ Leaf area and leaf dry mass increased by warming, but only in *Dryas* heath



Explained trait variation

- ✓ Large trait variation among habitats (sites) – dominated by interspecific variation (species turnover)
- ✓ Very little variation in traits explained by treatment, but when there is, it tends to be best described by intraspecific trait variation (ITV)



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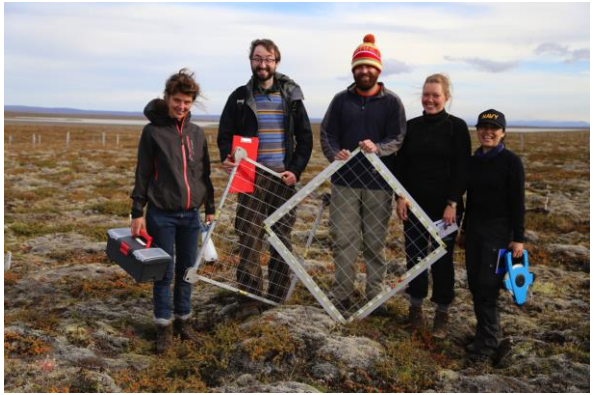
Thank you for listening!



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