Intraspecific trait variation

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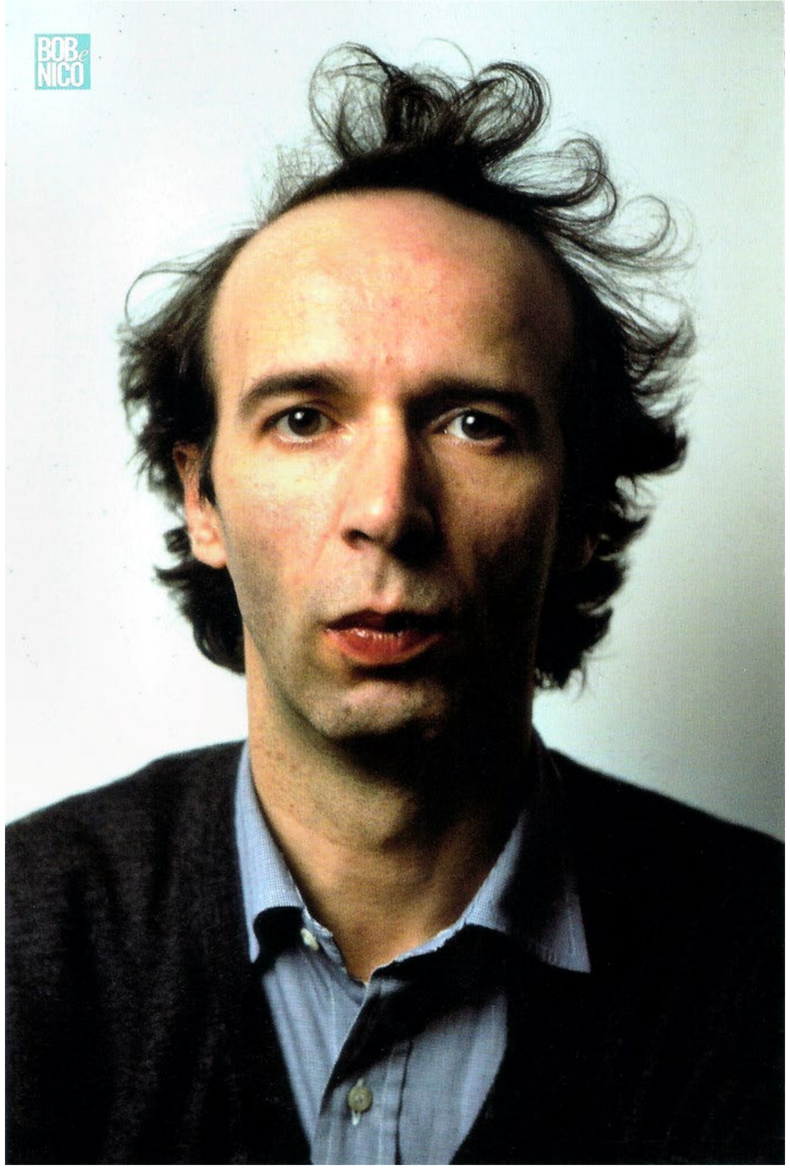
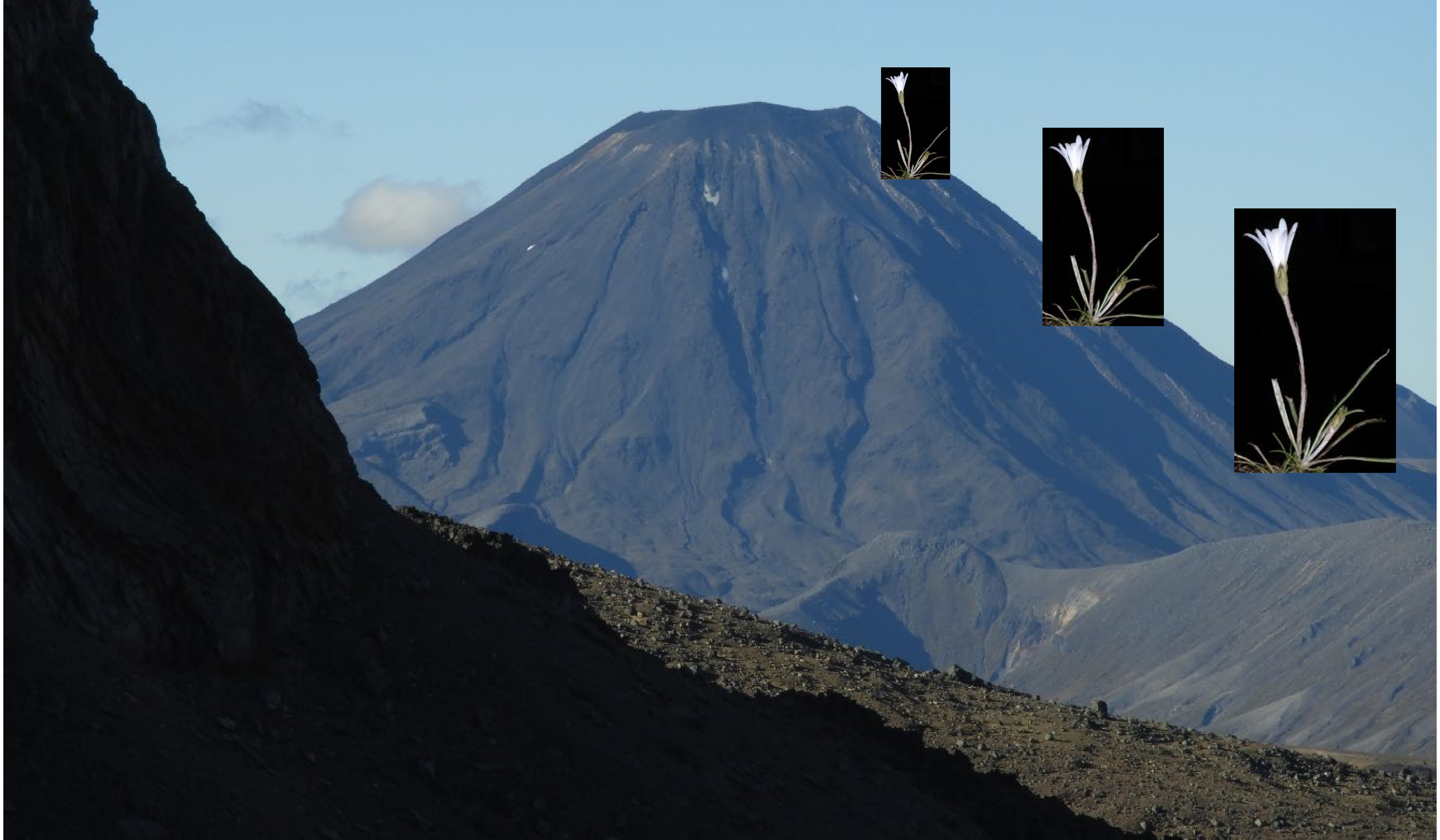


Intraspecific trait variation in alpine plants relates to their elevational distribution



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RESEARCH ARTICLE

Intraspecific trait variation in alpine plants relates to their elevational distribution

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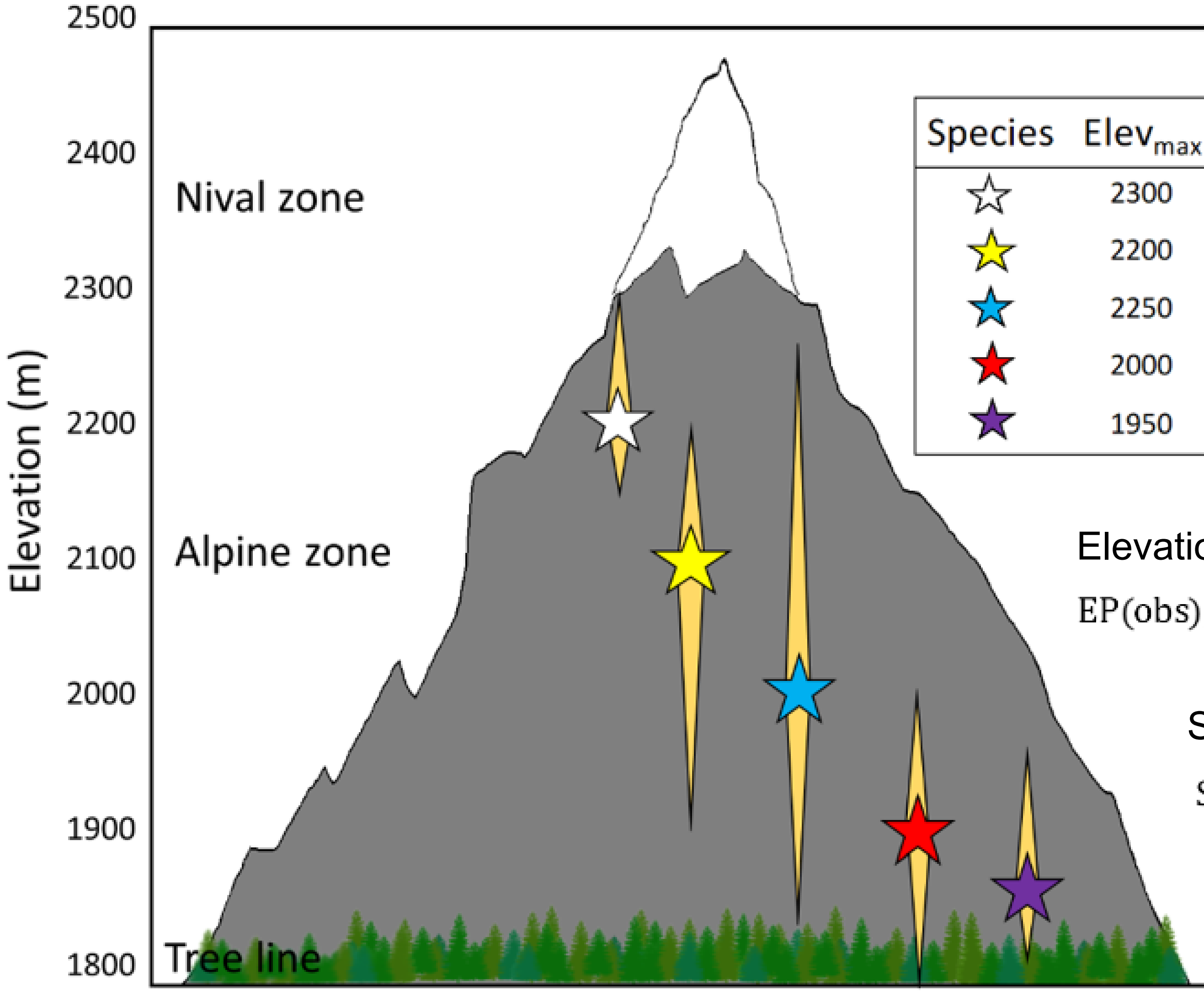


Species	$Elev_{max}$	$Elev_{median}$	$Elev_{min}$	EP	SR
☆	2300	2200	2150	0.8	0.3
★	2200	2100	1900	0.6	0.6
★	2250	2000	1850	0.4	0.8
★	2000	1900	1800	0.2	0.4
★	1950	1850	1800	0.1	0.3

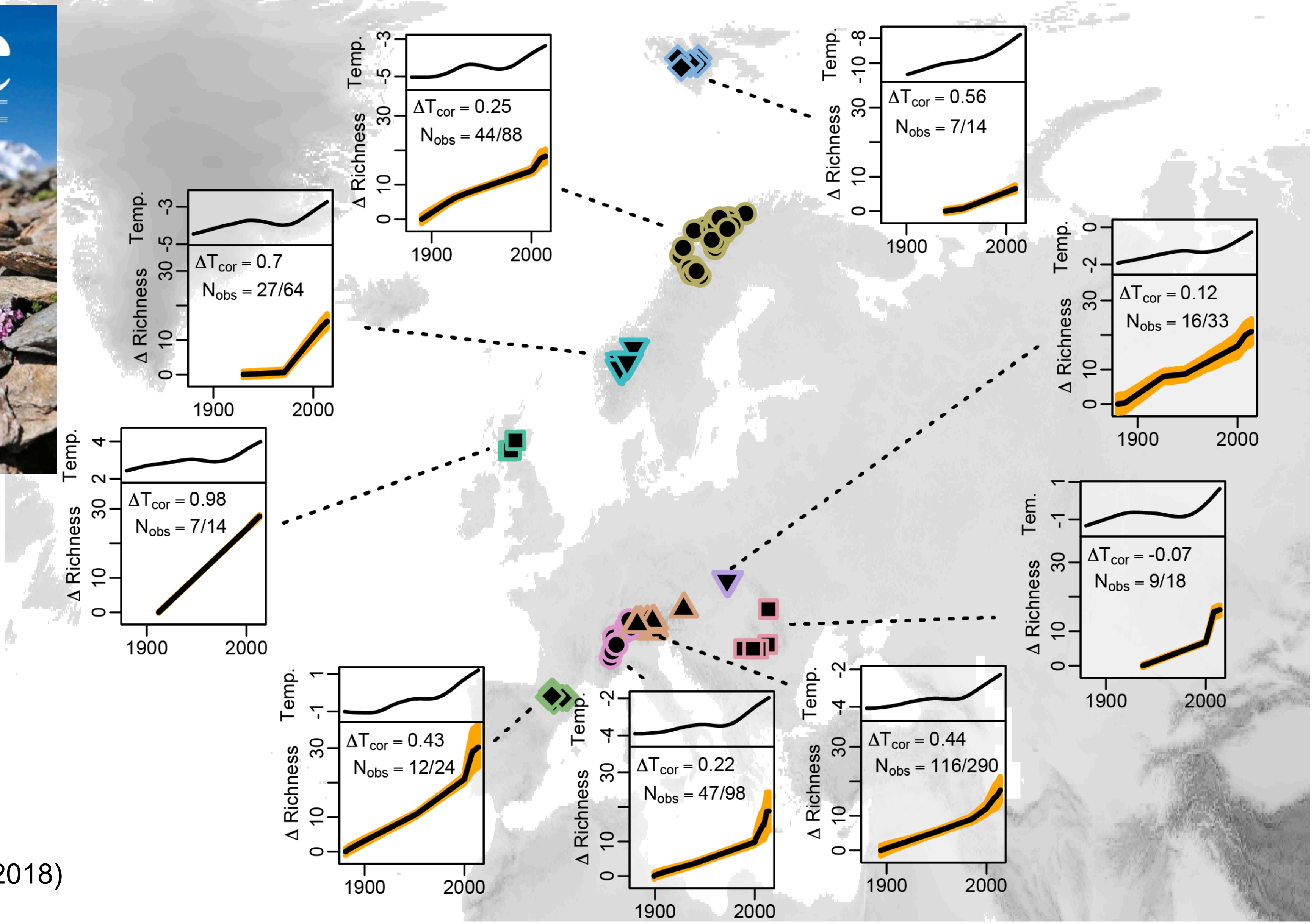
Elevation Preference EP

$$EP(obs)_{ij} = 1 + \left[\frac{Elev\,(median)_{ij} - Elev(max)_j}{Elev(max)_j - Elev\,(min)_j}\right]$$

Species Range SR

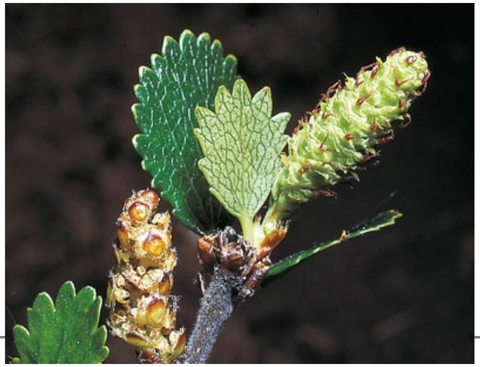
$$SR\,(obs)_{ij} = \left[\frac{Elev(max)_{ij} - Elev\,(min)_{ij}}{Elev(max)_j - Elev\,(min)_j}\right]$$

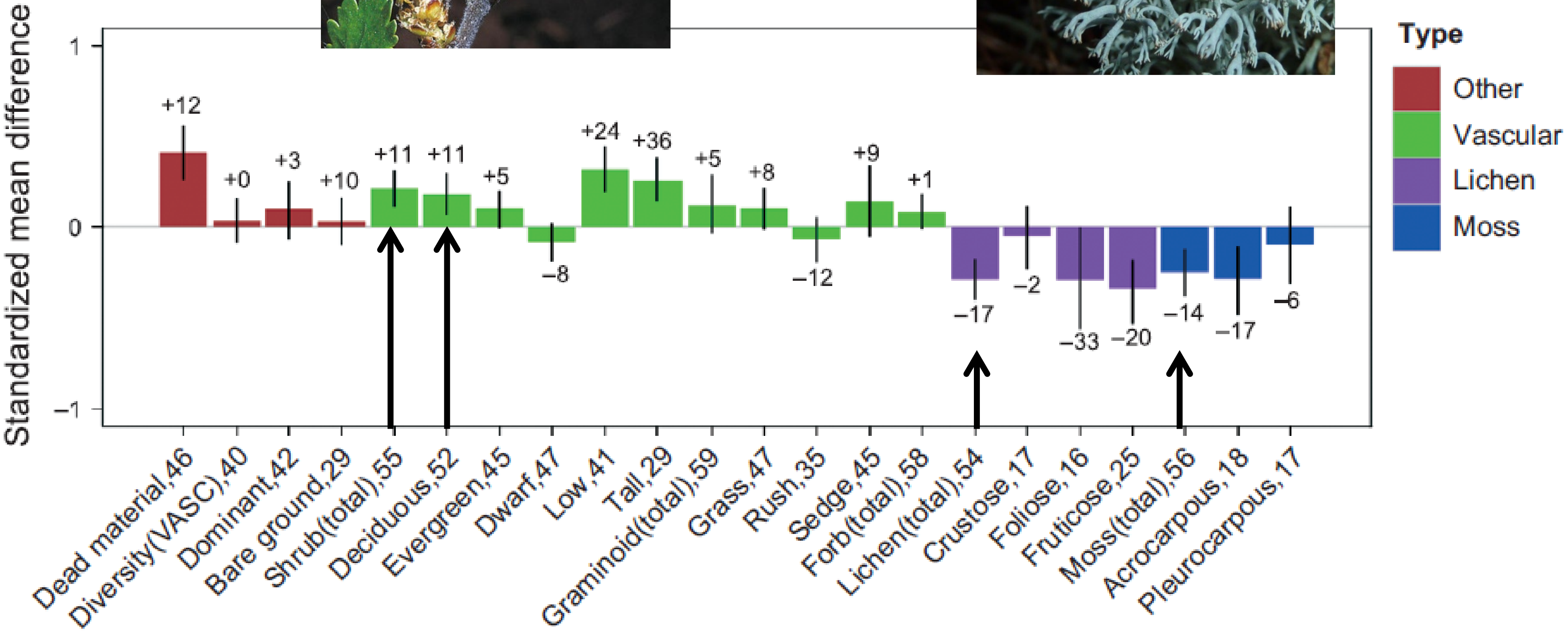
Climate Warming Accelerates Increase in Plant Species Richness on Arctic and Alpine Summits



(Steinbauer et al. 2018)

Global assessment: winners and losers





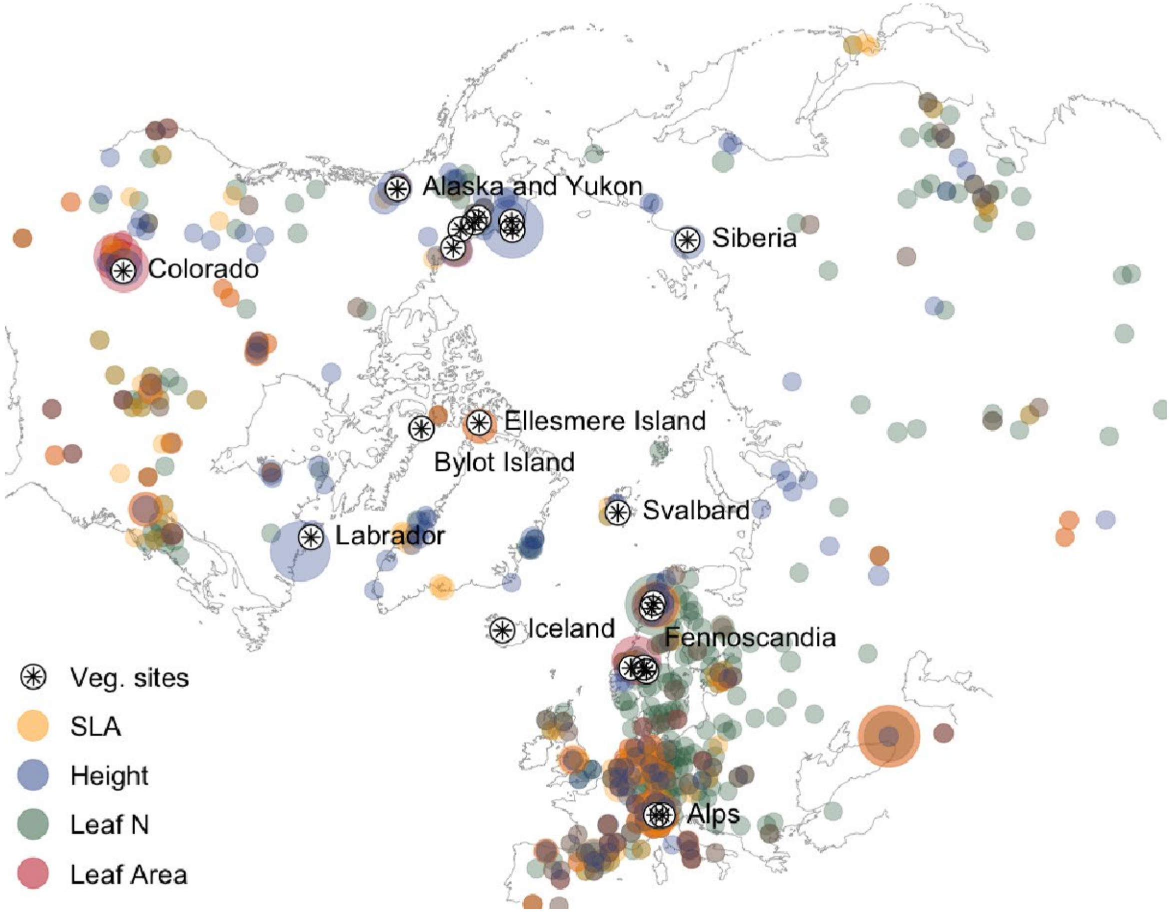
→ Change in cover in response to warming

(Elmendorf et al. 2012)

Betula nana, Dwarf birch

Photo: LTER

TTT Tundra community & trait composition over space and time



Veg. surveys:

9,800 plots

117 sites in 38 regions

27 years

Traits:

56,048 observations

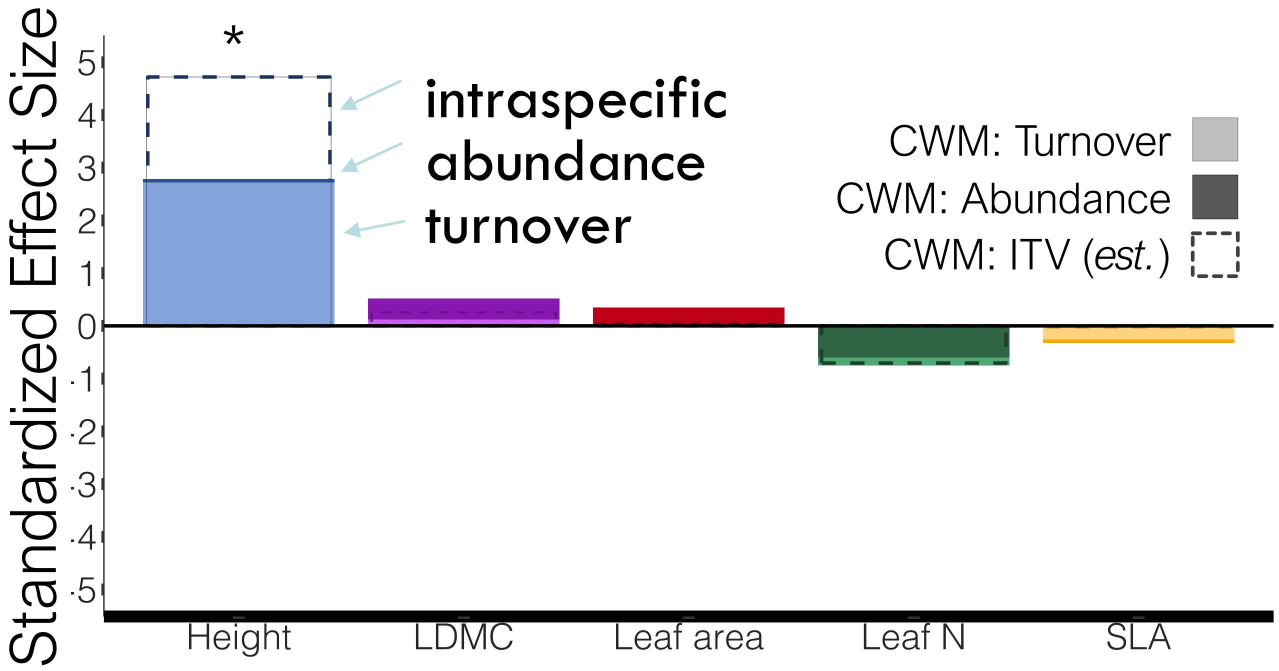
5 functional traits

Temperature (WorldClim, CRU)

ITEX, Tundra Trait Team and TRY data

Bjorkman et al. 2018, Nature

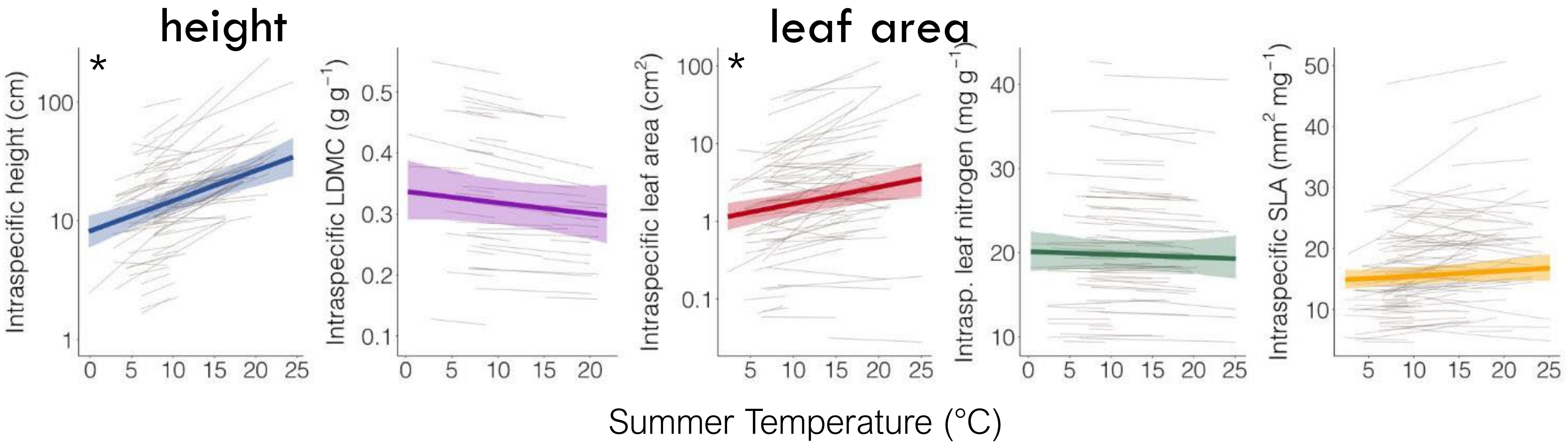
Trait change: Variation over time



Change in tundra vegetation height over time attributed to turnover and intraspecific variation

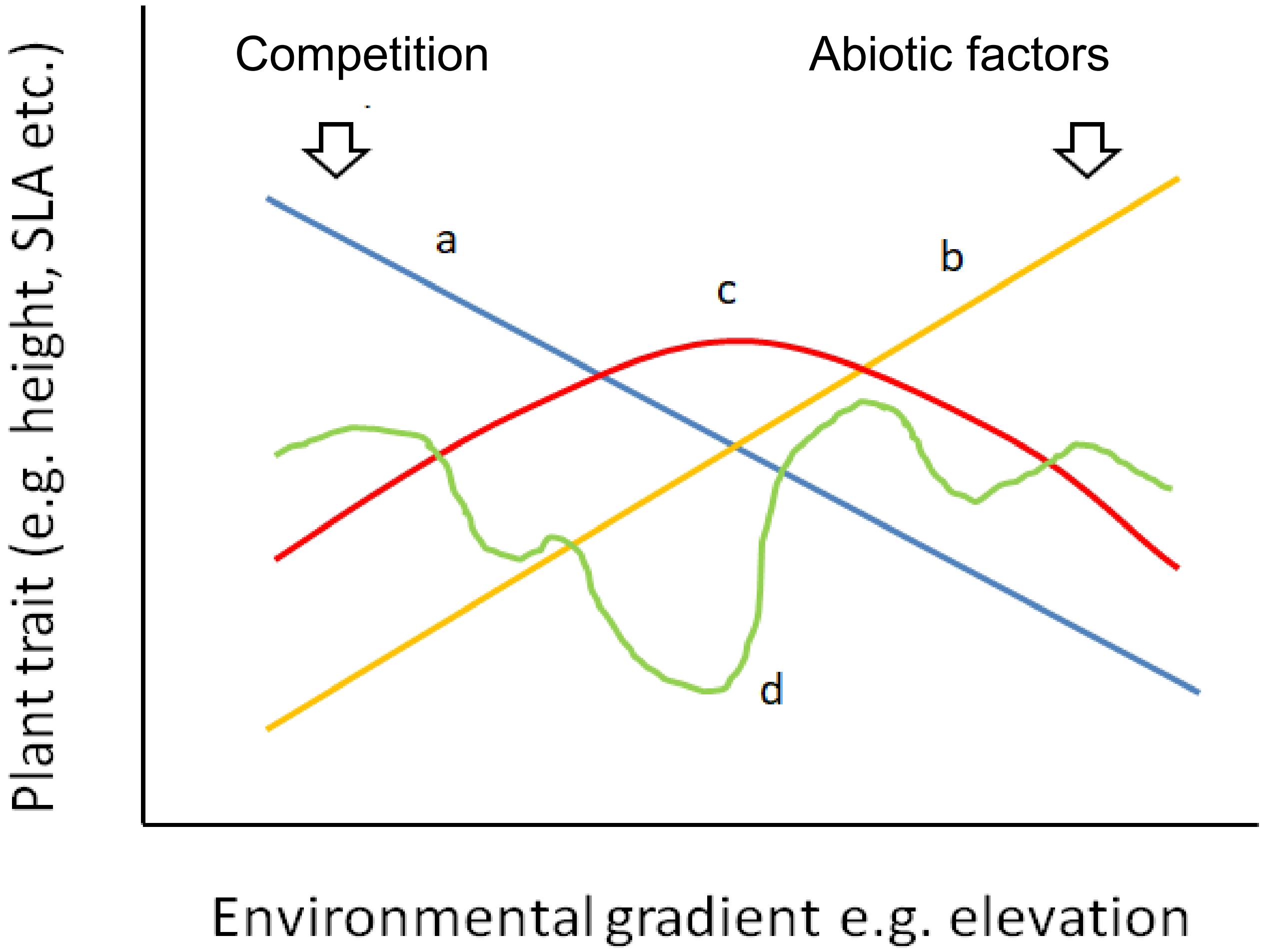
Bjorkman et al., Nature 2018

Intraspecific traits: Variation over space



Intraspecific temperature-trait relationships only for size-related traits

Intraspecific trait distribution along environmental gradients



Sampling along entire elevation range of species

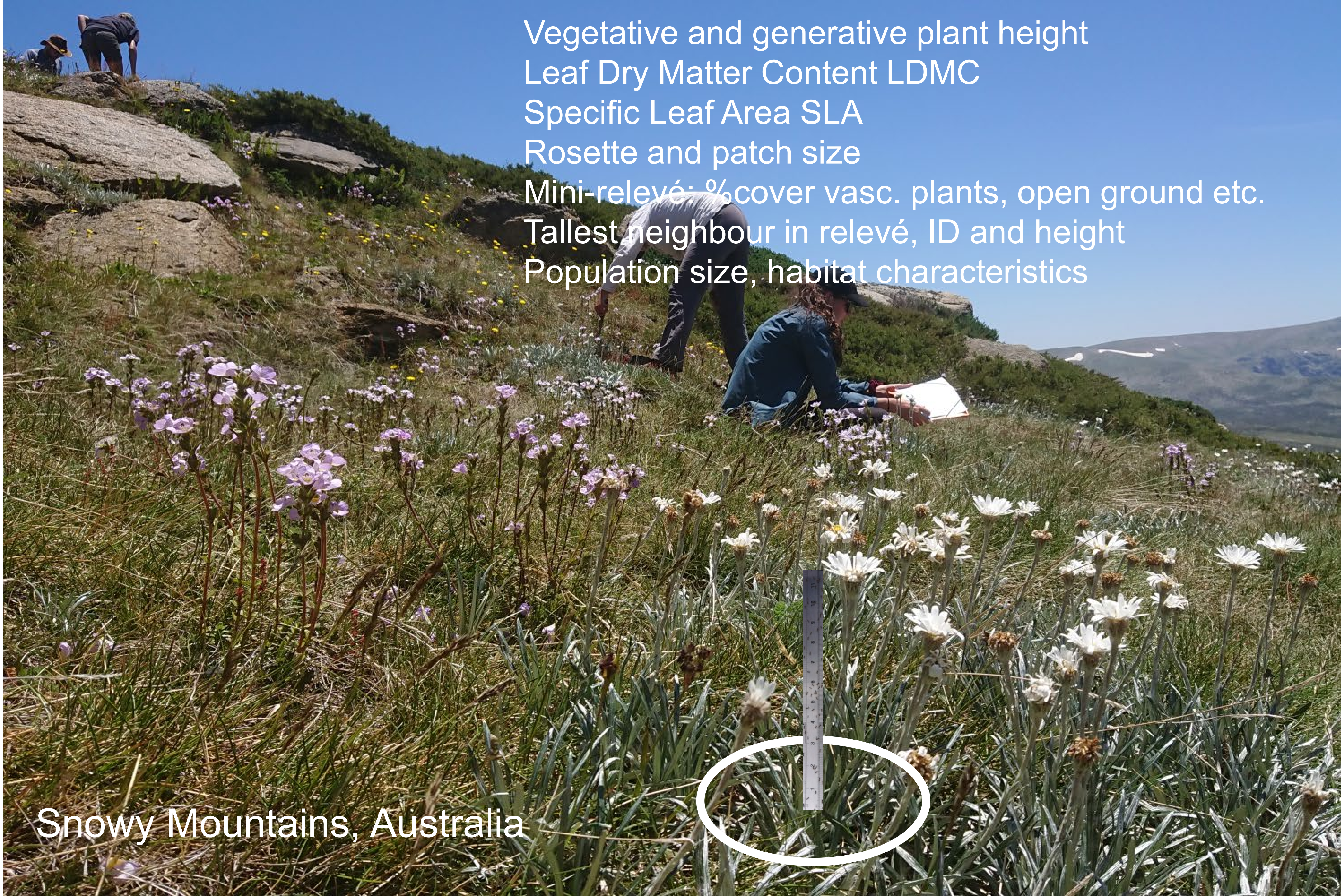
Sampling in 4 countries on 11+ mountains each

Plant populations every 50 – 200 m, depending on available range

Total 70+ plant species

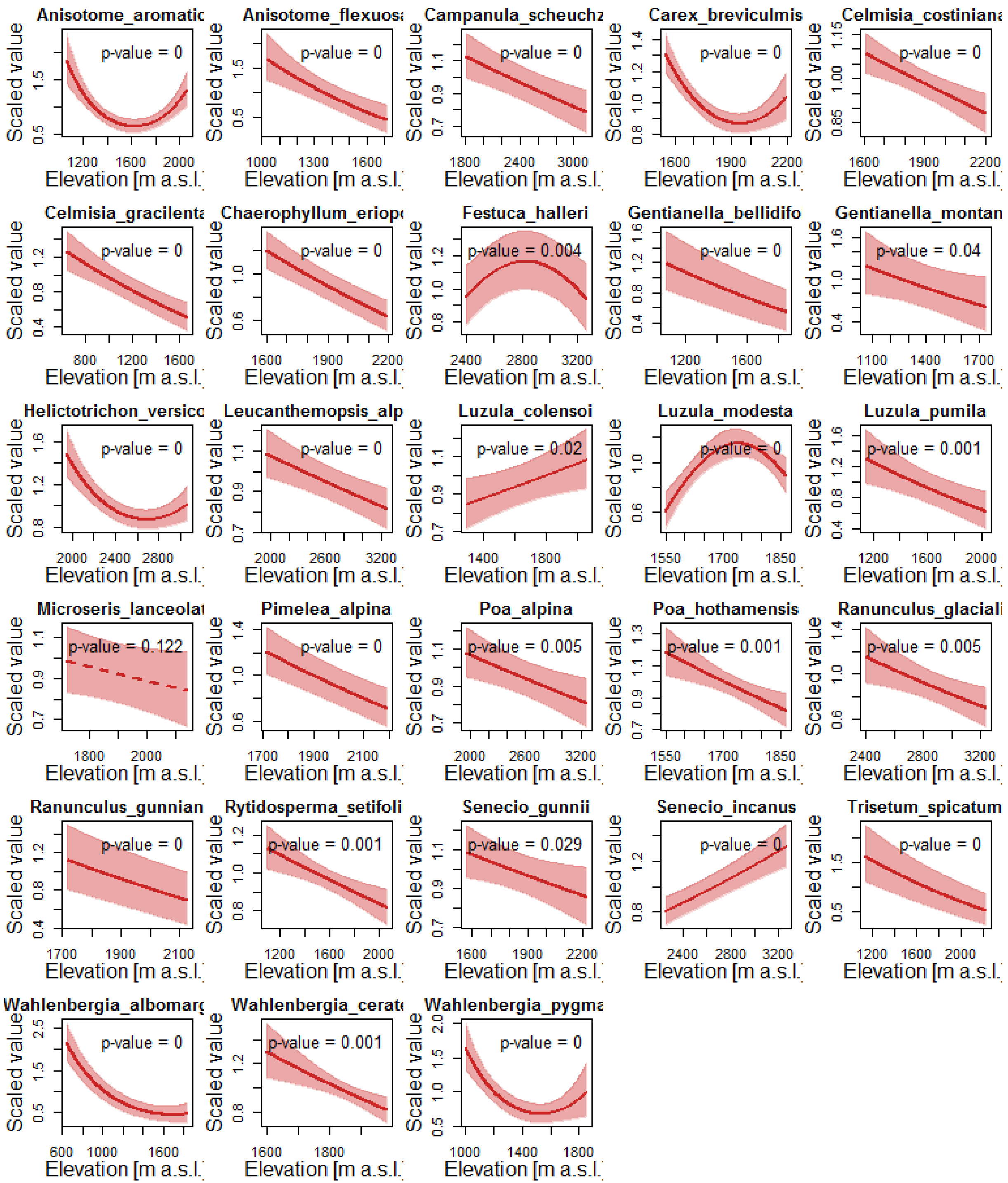
Species covering a range from high- to low-alpine

Tongariro, New Zealand

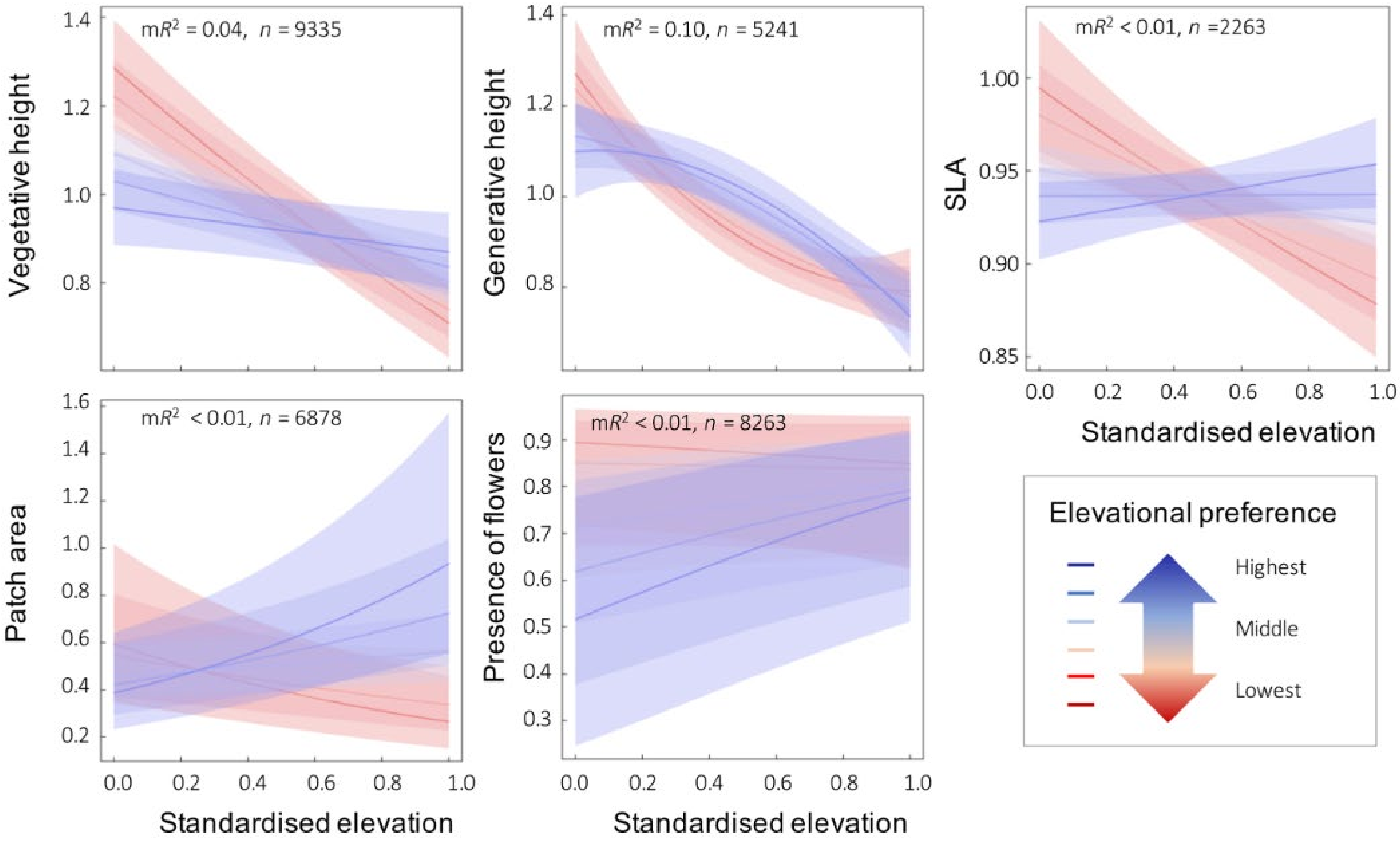

Vegetative and generative plant height
Leaf Dry Matter Content LDMC
Specific Leaf Area SLA
Rosette and patch size
Mini-relevé: %cover vasc. plants, open ground etc.
Tallest neighbour in relevé, ID and height
Population size, habitat characteristics
Snowy Mountains, Australia

Vegetative height of all species

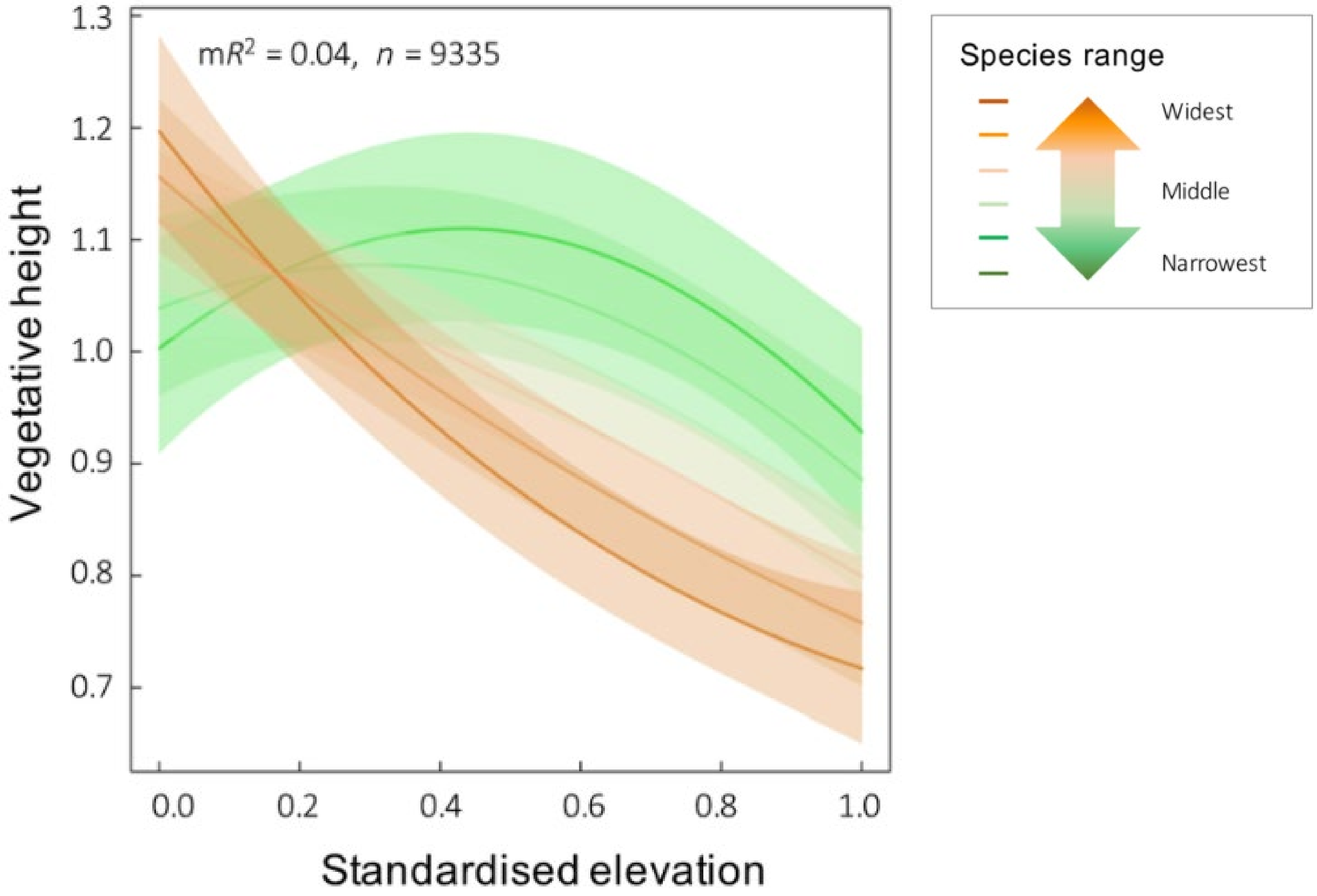
Carex breviculmis, OZ



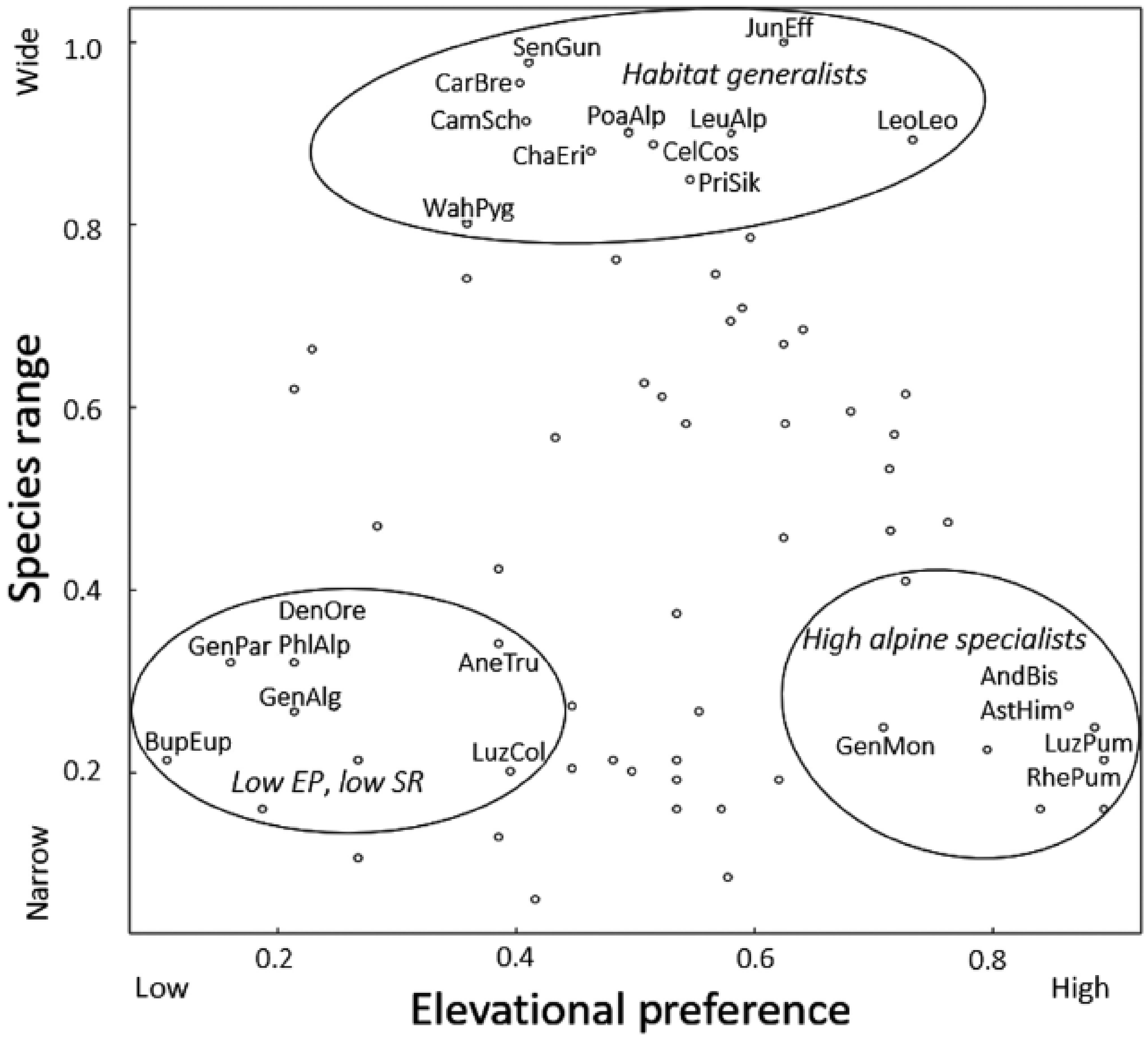
Plant traits by elevational preference



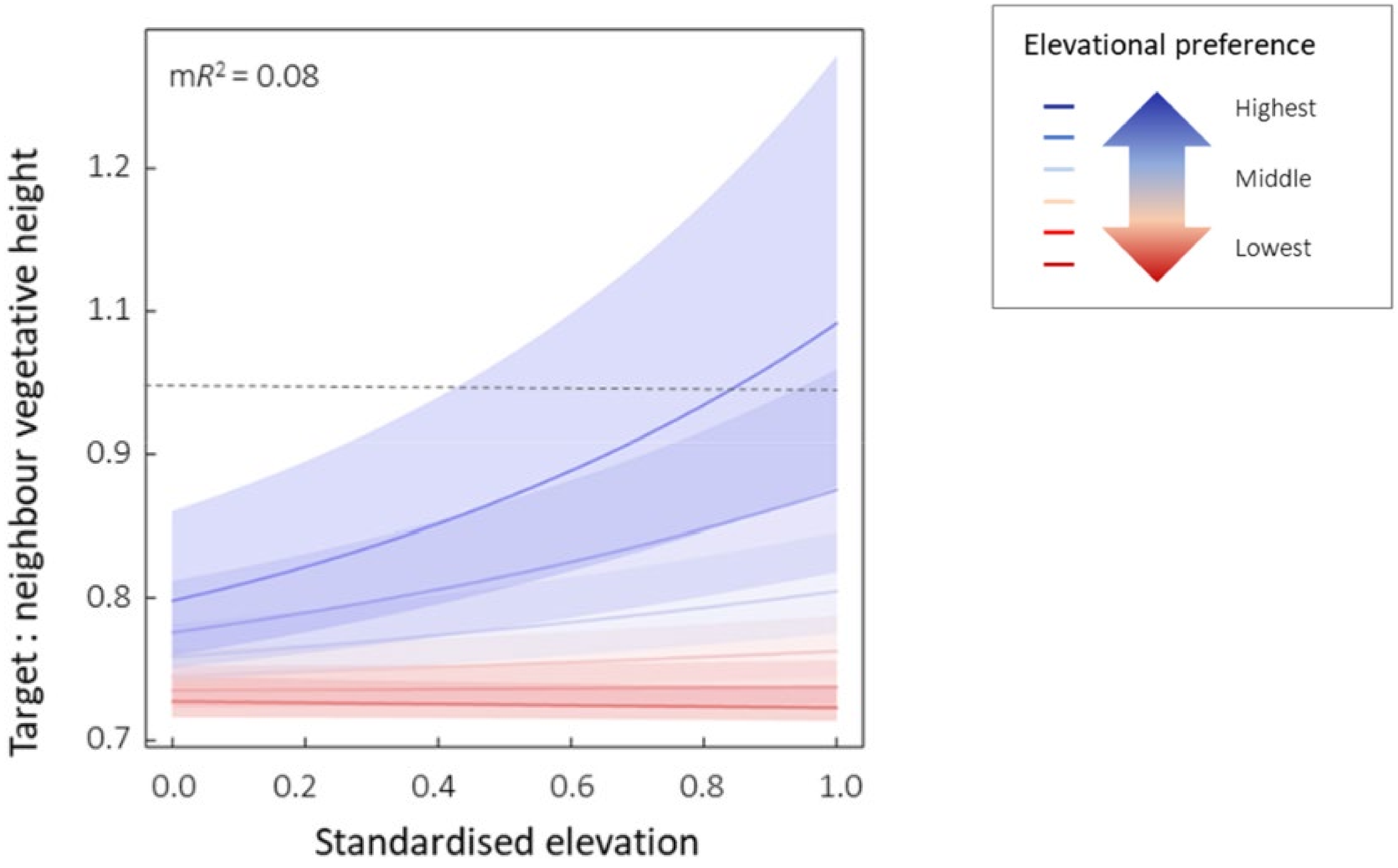
Plant traits by species range



Weak relationship between elevational preference and species range



Ratio of target and neighbour vegetative height



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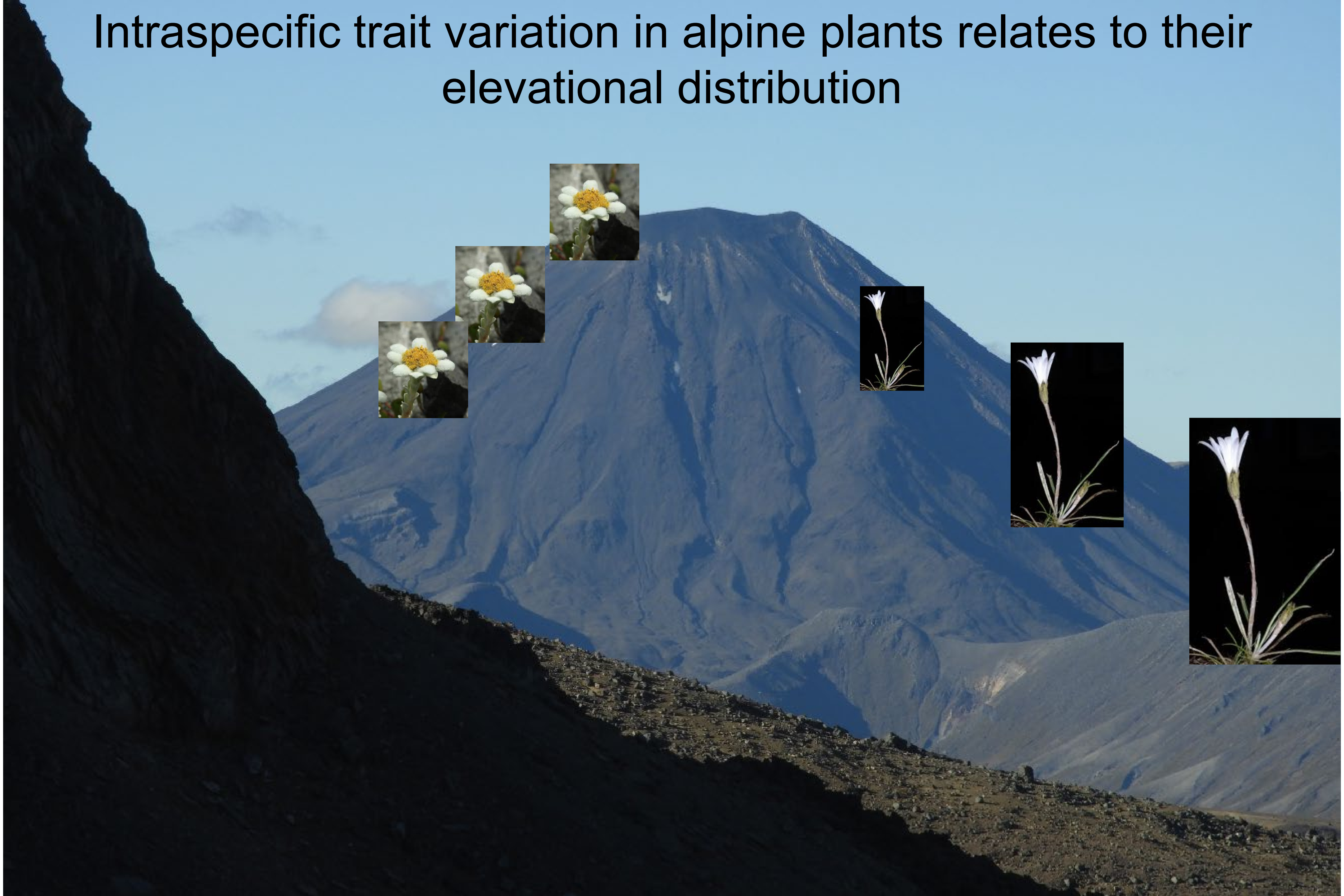


Intraspecific trait variation in alpine plants relates to their elevational distribution

Conclusions

- Plant species that prefer to grow at lower elevations display great trait variation.

- Plant species found at all elevations also exhibit great trait variation.

- Species that favour very high elevations show little trait variation.

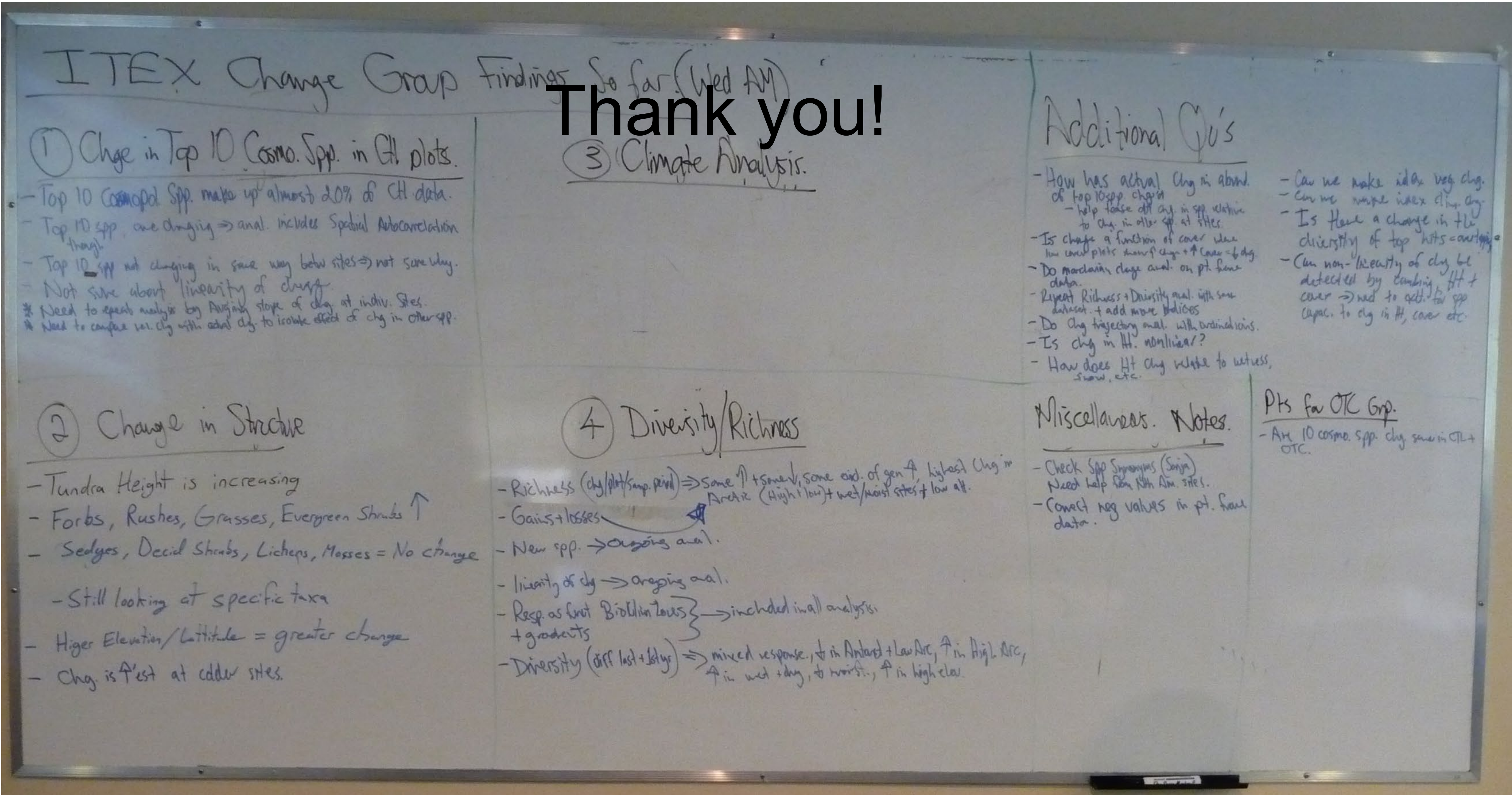
So, if variation is indeed a key factor for rapid and successful adaptation to climate change, then alpine specialists run the risk of falling behind and being squeezed out by more ubiquitous species and generalists.

Next questions:

- Plasticity or genetic variation?

- Is being conservative a disadvantage, being variable an advantage in climate change?

Thank you!


ITEX Change Group Findings So far (Wed AM)
1 Chge in Top 10 Cosmo. Spp. in Ctl plots.
- Top 10 Cosmopol Spp. make up almost 20% of Ctl data.
- Not sure about linearity of chng.
2 Change in Structure
- Tundra Height is increasing
- Forbs, Rushes, Grasses, Evergreen Shrubs ↑
- Sedges, Decid Shrubs, Lichens, Mosses = No change
- Still looking at specific taxa
- Higer Elevation/Lattitude = greater change
- Chg. is ↑'est at colder sites.
3 Climate Analysis.
4 Diversity/Richness
- Gains + losses
- New spp. → ongoing anal.
- linearity of chg → ongoing anal.
Additional Qu's
- Is chg in Ht. nonlinear?
Miscellaneous. Notes.
- Check Spp Synonyms (Sonja)
- Correct neg values in pt. frame data.
Pts for OTC Grp.
- Are 10 cosmo. spp. chg same in CTL + OTC.

Thank you!

Fiordland, South Island NZ