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Appendix 1

Table A1. Species sampled in each transect.

Transect	Species
	Baldy
A	Achnatherum sp. (Poaceae) Agoseris glauca (Asteraceae) Arenaria congesta (Caryophyllaceae) Eriogonum umbellatum (Polygonaceae) Heterotheca villosa (Asteraceae) Ivesia gordonii (Rosaceae) Lupinus argenteus (Fabaceae) Senecio crassulus (Asteraceae)
B	Achnatherum sp. (Poaceae) Lupinus argenteus (Fabaceae) Senecio crassulus (Asteraceae) Agoseris glauca (Asteraceae) Elymus lanceolatus (Poaceae) Phacelia sp. (Boraginaceae) Eriogonum umbellatum (Polygonaceae) Heterotheca villosa (Asteraceae)
C	Agoseris glauca (Asteraceae) Elymus lanceolatus (Poaceae) Eriogonum umbellatum (Polygonaceae) Heterotheca villosa (Asteraceae) Lupinus argenteus (Fabaceae) Senecio crassulus (Asteraceae) Viola sp. (Violaceae) Indet 16 Indet 17

- D *Achnatherum* sp. (Poaceae)
 Agoseris glauca (Asteraceae)
 Elymus lanceolatus (Poaceae)
 Eriogonum umbellatum (Polygonaceae)
 Heterotheca villosa (Asteraceae)
 Lupinus argenteus (Fabaceae)
 Senecio crassulus (Asteraceae)
 Indet 15
- E *Agoseris glauca* (Asteraceae)
 Androsace septentrionalis (Primulaceae)
 Elymus lanceolatus (Poaceae)
 Eriogonum umbellatum (Polygonaceae)
 Heterotheca villosa (Asteraceae)
 Ivesia gordonii (Rosaceae)
 Lupinus argenteus (Fabaceae)
 Senecio crassulus (Asteraceae)
 Viola sp. (Violaceae)

Cinnamon

Transect	Species
A	<i>Arctostaphylos uva-ursi</i> (Ericaceae) <i>Arenaria congesta</i> (Caryophyllaceae) <i>Arnica latifolia</i> (Asteraceae) <i>Elymus lanceolatus</i> (Poaceae) <i>Erythronium grandiflorum</i> (Liliaceae) <i>Helianthella quinquenervis</i> (Asteraceae) <i>Juncus drummondii</i> (Juncaceae) <i>Senecio crassulus</i> (Asteraceae) Indet 1 Indet 2 Indet 7
B	<i>Achillea millefolium</i> (Asteraceae) <i>Arctostaphylos uva-ursi</i> (Ericaceae) <i>Arnica latifolia</i> (Asteraceae) <i>Elymus lanceolatus</i> (Poaceae) <i>Erythronium grandiflorum</i> (Liliaceae) <i>Juncus drummondii</i> (Juncaceae) <i>Viola adunca</i> (Violaceae) Indet 1 Indet 4 Indet 15
C	<i>Arctostaphylos uva-ursi</i> (Ericaceae) <i>Arnica latifolia</i> (Asteraceae)

Elymus lanceolatus (Poaceae)
Erythronium grandiflorum (Liliaceae)
Juncus drummondii (Juncaceae)
Setum roseum (Crassulaceae)
Viola adunca (Violaceae)
 Indet 1
 Indet 4
 Indet 7

D *Arctostaphylos uva-ursi* (Ericaceae)
Arnica latifolia (Asteraceae)
Elymus lanceolatus (Poaceae)
Erythronium grandiflorum (Liliaceae)
Fragaria virginiana (Rosaceae)
 Grass *Viola adunca* (Violaceae)
Juncus drummondii (Juncaceae)
Senecio crassulus (Asteraceae)
Viola adunca (Violaceae)
 Indet 4
 Indet 9

E *Agoseris glauca* (Asteraceae)
Arctostaphylos uva-ursi (Ericaceae)
Bistorta bistortoides (Polygonaceae)
Castilleja sulphurea (Scrophulariaceae)
Elymus lanceolatus (Poaceae)
Fragaria virginiana (Rosaceae)
Juncus drummondii (Juncaceae)
Senecio crassulus (Asteraceae)
Viola adunca (Violaceae)
 Indet 1
 Indet 10

Painter Boy Mine

Transect	Species
A	<i>Achillea millefolium</i> (Asteraceae) <i>Androsace septentrionalis</i> (Primulaceae) <i>Eriogonum umbellatum</i> (Polygonaceae) <i>Erythronium grandiflorum</i> (Liliaceae) <i>Fragaria virginiana</i> (Rosaceae) <i>Heterotheca villosa</i> (Asteraceae) Indet 1 Indet 8
B	<i>Androsace septentrionalis</i> (Primulaceae) <i>Festuca thurberi</i> (Poaceae)

Fragaria virginiana (Rosaceae)
Heterotheca villosa (Asteraceae)
Hymenoxys hoopesii (Asteraceae)
Ligusticum porteri (Apiaceae)
Potentilla gracilis (Rosaceae)
Senecio crassulus (Asteraceae)
Indet 1
Indet 6
Indet 8

C Corydalis caseana (Papaveraceae)
Erythronium grandiflorum (Liliaceae)
Fragaria virginiana (Rosaceae)
Mertensia ciliata (Boraginaceae)
Potentilla gracilis (Rosaceae)
Veratrum californicum (Melanthiaceae)
Indet 1
Indet 6

D Aquilegia caerulea (Ranunculaceae)
Draba aurea (Brassicaceae)
Erythronium grandiflorum (Liliaceae)
Geranium richardsonii (Geraniaceae)
Mertensia ciliata (Boraginaceae)
Potentilla gracilis (Rosaceae)
Valeriana edulis (Caprifoliaceae)
Valeriana occidentalis (Valerianaceae)
Veratrum californicum (Melanthiaceae)
Indet 3
Indet 6

E Aquilegia caerulea (Ranunculaceae)
Chamerion angustifolium (Onagraceae)
Corydalis caseana (Papaveraceae)
Draba aurea (Brassicaceae)
Erythronium grandiflorum (Liliaceae)
Fragaria virginiana (Rosaceae)
Geranium richardsonii (Geraniaceae)
Mertensia ciliata (Boraginaceae)
Potentilla gracilis (Rosaceae)
Valeriana edulis (Caprifoliaceae)
Valeriana occidentalis (Valerianaceae)
Veratrum californicum (Melanthiaceae)
Indet 6
Indet 8

Pfeiler	
Transect	Species
A	<i>Collomia linearis</i> (Polemoniaceae)
	<i>Lathyrus lanszwertii</i> v. <i>leucanthus</i> (Fabaceae)
	<i>Ligusticum porteri</i> (Apiaceae)
	<i>Thalictrum fendleri</i> (Ranunculaceae)
	<i>Valeriana occidentalis</i> (Valerianaceae)
	<i>Viola nuttallii</i> (Violaceae)
	Indet 6
	Indet 19
	Indet 20
	Indet 21
	Indet 22
B	<i>Castilleja sulphurea</i> (Scrophulariaceae)
	<i>Chamerion angustifolium</i> (Onagraceae)
	<i>Delphinium barbeyi</i> (Ranunculaceae)
	<i>Erigeron</i> sp. (Asteraceae)
	<i>Erythronium grandiflorum</i> (Liliaceae)
	<i>Helianthella quinquenervis</i> (Asteraceae)
	<i>Heracleum sphondylium</i> (Apiaceae)
	<i>Hydrophyllum fendleri</i> (Hydrophyllaceae)
	<i>Ligusticum porteri</i> (Apiaceae)
	<i>Lupinus bakeri</i> (Fabaceae)
	<i>Potentilla gracilis</i> (Rosaceae)
	<i>Thalictrum fendleri</i> (Ranunculaceae)
	<i>Valeriana occidentalis</i> (Valerianaceae)
	<i>Veratrum californicum</i> (Melanthiaceae)
	<i>Vicia americana</i> (Fabaceae)
	<i>Viola nuttallii</i> (Violaceae)
	Indet 3
Indet 5	
Indet 14	
C	<i>Delphinium barbeyi</i> (Ranunculaceae)
	<i>Erythronium grandiflorum</i> (Liliaceae)
	<i>Festuca thurberi</i> (Poaceae)
	<i>Heracleum sphondylium</i> (Apiaceae)
	<i>Hydrophyllum fendleri</i> (Hydrophyllaceae)
	<i>Ligusticum filicinum</i> (Apiaceae)
	<i>Mertensia ciliata</i> (Boraginaceae)
<i>Veratrum californicum</i> (Melanthiaceae)	
D	<i>Aquilegia caerulea</i> (Ranunculaceae)
	<i>Bromus</i> sp. (Poaceae)

Castilleja sulphurea (Scrophulariaceae)
 Chamerion angustifolium (Onagraceae)
 Erigeron speciosus (Asteraceae)
 Erythronium grandiflorum (Liliaceae)
 Festuca thurberi (Poaceae)
 Helianthella quinquenervis (Asteraceae)
 Hydrophyllum fendleri (Hydrophyllaceae)
 Lathyrus lanszwertii v. leucanthus (Fabaceae)
 Ligusticum porteri (Apiaceae)
 Potentilla gracilis (Rosaceae)
 Thalictrum fendleri (Ranunculaceae)
 Veratrum californicum (Melanthiaceae)
 Vicia americana (Fabaceae)
 Viola nuttallii (Violaceae)

Indet 5

Indet 11

E Chamerion angustifolium (Onagraceae)
 Delphinium barbeyi (Ranunculaceae)
 Erythronium grandiflorum (Liliaceae)
 Festuca thurberi (Poaceae)
 Geranium richardsonii (Geraniaceae)
 Helianthella quinquenervis (Asteraceae)
 Lathyrus lanszwertii v. leucanthus (Fabaceae)
 Ligusticum filicinum (Apiaceae)
 Ligusticum porteri (Apiaceae)
 Mertensia ciliata (Boraginaceae)
 Valeriana occidentalis (Valerianaceae)
 Veratrum californicum (Melanthiaceae)
 Indet 6
 Indet 12

Road

Transect	Species
A	Artemisia tridentata (Asteraceae)
	Chenopodium atrovirens (Amaranthaceae)
	Chrysothamnus viscidiflorus (Asteraceae)
	Collomia linearis (Polemoniaceae)
	Delphinium nuttallianum (Ranunculaceae)
	Erigeron speciosus (Asteraceae)
	Festuca thurberi (Poaceae)
	Geranium richardsonii (Geraniaceae)
	Hymenoxys hoopesii (Asteraceae)
	Lathyrus lanszwertii v. leucanthus (Fabaceae)

- Lupinus bakeri (Fabaceae)
 Valeriana occidentalis (Valerianaceae)
- B Achillea millefolium (Asteraceae)
 Bromus sp. (Poaceae)
 Chenopodium atrovirens (Amaranthaceae)
 Collomia linearis (Polemoniaceae)
 Delphinium nuttallianum (Ranunculaceae)
 Festuca thurberi (Poaceae)
 Geranium richardsonii (Geraniaceae)
 Lathyrus lanszwertii v. leucanthus (Fabaceae)
 Lupinus bakeri (Fabaceae)
 Potentilla fruticosa (Rosaceae)
 Potentilla gracilis (Rosaceae)
 Taraxacum officinale (Asteraceae)
 Valeriana occidentalis (Valerianaceae)
- C Artemisia tridentata (Asteraceae)
 Achillea millefolium (Asteraceae)
 Artemisia tridentata (Asteraceae)
 Bromus sp. (Poaceae)
 Chrysothamnus viscidiflorus (Asteraceae)
 Collomia linearis (Polemoniaceae)
 Festuca thurberi (Poaceae)
 Geranium richardsonii (Geraniaceae)
 Hymenoxys hoopesii (Asteraceae)
 Potentilla fruticosa (Rosaceae)
 Potentilla gracilis (Rosaceae)
 Ranunculus sp. (Ranunculaceae)
 Taraxacum officinale (Asteraceae)
 Valeriana occidentalis (Valerianaceae)
 Indet 13
- D Artemisia tridentata (Asteraceae)
 Bromus sp. (Poaceae)
 Cirsium sp. (Asteraceae)
 Collomia linearis (Polemoniaceae)
 Erigeron speciosus (Asteraceae)
 Festuca thurberi (Poaceae)
 Hymenoxys hoopesii (Asteraceae)
 Lathyrus lanszwertii v. leucanthus (Fabaceae)
 Lupinus bakeri (Fabaceae)
 Phleum pratense (Poaceae)
 Rumex densiflorus (Polygonaceae)
 Taraxacum officinale (Asteraceae)
 Valeriana occidentalis (Valerianaceae)

E *Achillea millefolium* (Asteraceae)
 Bromus sp. (Poaceae)
 Festuca thurberi (Poaceae)
 Fragaria virginiana (Rosaceae)
 Geum triflorum (Rosaceae)
 Lupinus bakeri (Fabaceae)
 Mertensia ciliata (Boraginaceae)
 Potentilla fruticosa (Rosaceae)
 Potentilla gracilis (Rosaceae)
 Pseudocymopterus montanus (Apiaceae)
 Rumex densiflorus (Polygonaceae)
 Senecio bigelovii (Asteraceae)
 Taraxacum officinale (Asteraceae)
 Thalictrum fendleri (Ranunculaceae)
 Trifolium sp. (Fabaceae)
 Valeriana occidentalis (Valerianaceae)
 Indet 18

Table A2. Percent of deviance in linear mixed models explained by each environmental variable. Each row contains results for a different modeled trait.

Effect of:	Mean moisture	Variation in moisture	Mean temperature	Variation in temperature
Height	16.6	0.14	17.1	3.3
LDMC	11.7	3.6	9.1	1.0
SLA	2.4	4.9	1.9	1.7
Leaf area	15.2	0.3	14.0	0.01

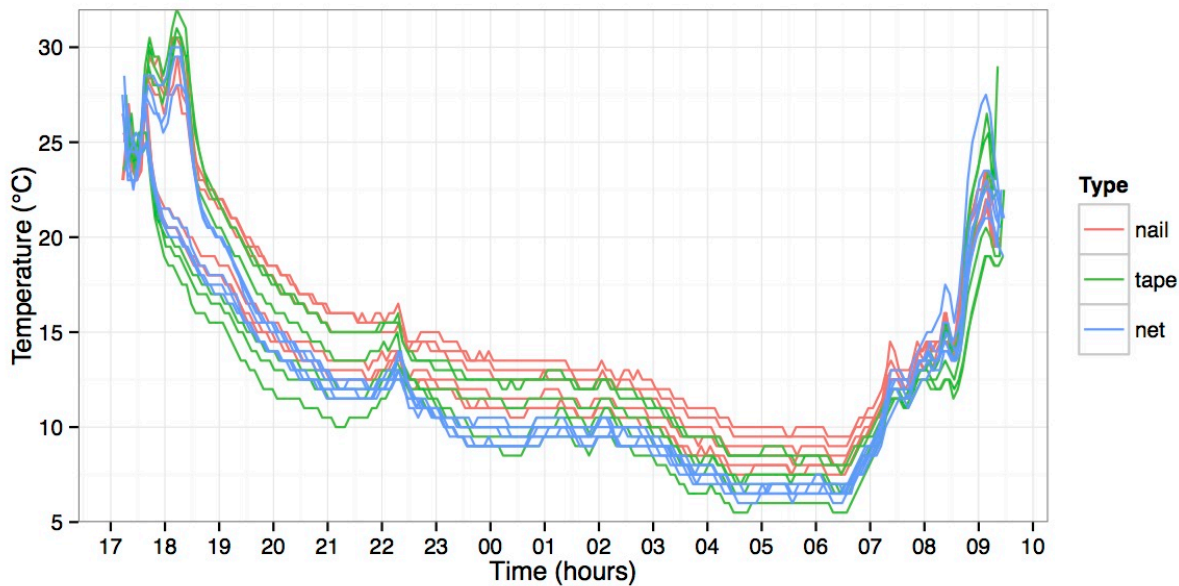


Figure A1. Results from iButton radiation shield design tests.

We explored three different possible structures that would minimize the effects of radiative loading on iButton temperature. To protect iButtons from damage, we wrapped each one in parafilm to create a moisture seal before continuing with each design plan. For the first design ('Nail'), each iButton was secured to the top of a galvanized steel nail using additional parafilm. For the second design, ('Tape'), each iButton was placed in a radiation shield pocket made of white Gorilla tape and then suspended from the top of a galvanized steel nail. For the third design ('Net'), we placed each iButton in the center of a pocket constructed of fiberglass screen-door material (5×5 cm) and then suspended these nets using one nail on each of the four corners. The height above ground was constant for each sample designs at 1–2 cm. For each treatment type, three nails were placed in varying environmental conditions from bare dirt to partially shaded. We tested the three sample designs over a 17 hour time period (17:00 – 10:00), then plotted the temperature over time for each of the three treatment types ($n = 3$).

We saw minimal variation among site types in temperature using the net design, and hypothesized that this may be a result of buffering from the ground temperature influence. This design also spiked in temperature in the early morning sun, potentially because solar heat was trapped in the netting. For the nail design, temperatures remained relatively high in comparison. However, we still saw a dulling of temperature variation, which we hypothesize may be a result of thermal buffering. We

concluded that the 'Tape' design allowed the most natural variation in temperature while minimizing solar heating.

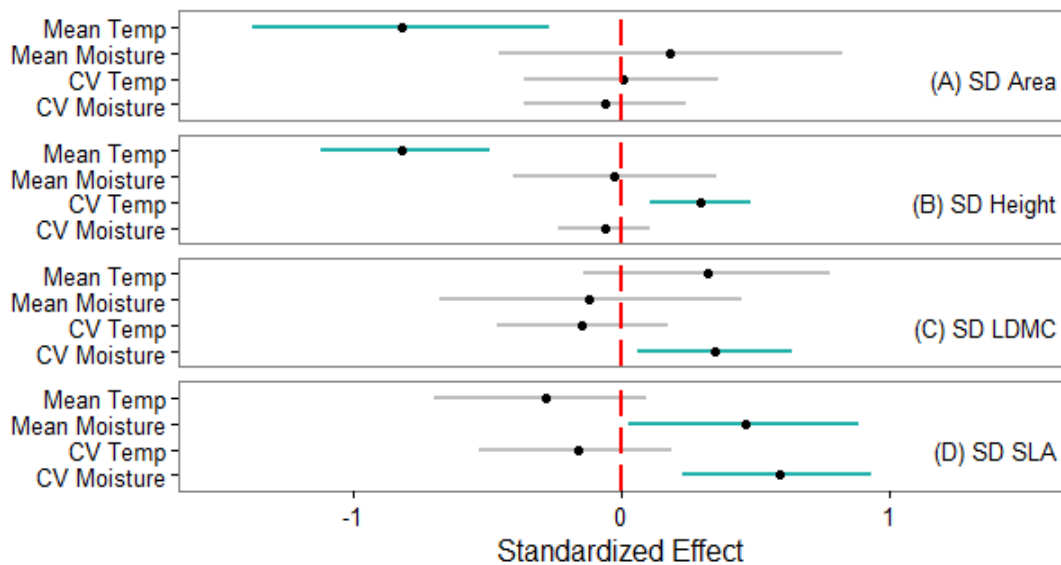


Figure A2. Linear mixed model with no imputed values for effect of environmental means and variation on standard deviation of (A) leaf area, (B) height, (C) leaf dry matter content (LDMC), and (D) specific leaf area (SLA). Horizontal bars show bootstrap 95% confidence intervals from a linear mixed model with all environmental variables for each trait. Bars colored blue have confidence intervals that do not overlap zero. Center points show parameter estimates. Omitting imputed values leads to largely the same model results (Fig. 4). Mean temperature no longer appears as a significant predictor of SD in LDMC. However, mean moisture and CV moisture emerge as significant predictors of SD in SLA. All other results remain the same. All significant correlations with CV in environmental variables are still positive, while significant correlations with mean environmental variables remain mixed.

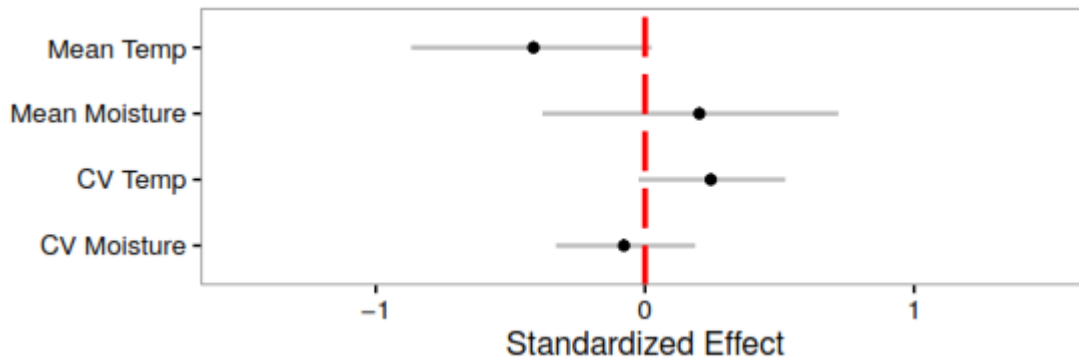


Figure A3. Effect of environmental means and variation on functional richness.

We calculated functional richness as the hull volume for all traits (scaled to mean of zero and standard deviation of 1) with the r package ‘geometry’ and repeated model calculation and testing as with individual traits. Horizontal bars show bootstrap 95% confidence intervals from a linear mixed model for functional richness with predictors defined as all environmental variables for each trait. All confidence intervals overlapped zero. Center points show parameter estimates. For this model, marginal R^2 was 0.331; conditional R^2 was 0.852.

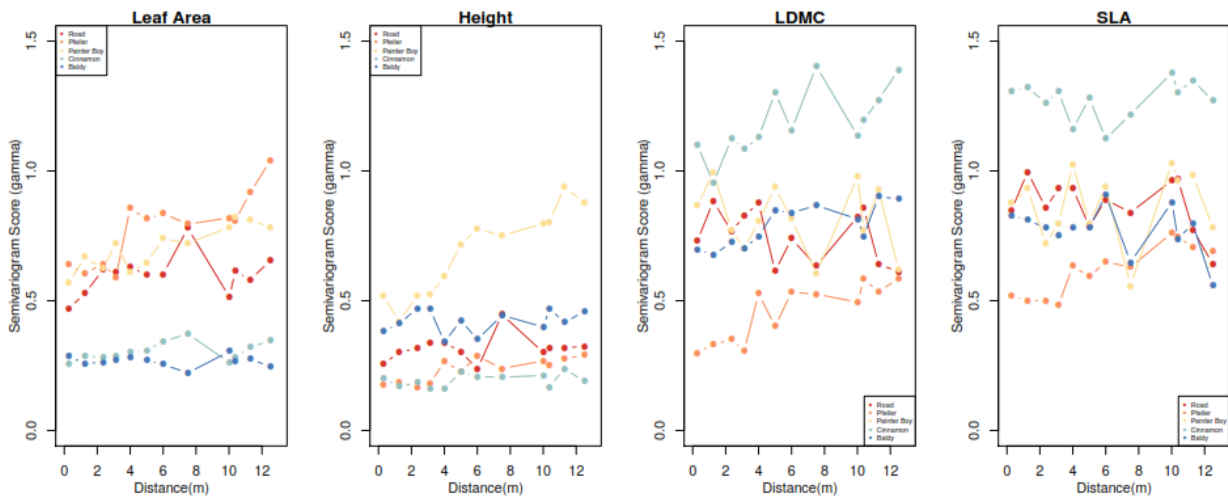


Figure A4. Results from spatial analyses. Semivariogram score (γ) versus distance (meters). The semivariogram allows us to visualize the spatial autocorrelation of our sample points. Here, gamma represents the correlation of data points and is measured over a distance scale, with color representing site.

To qualitatively assess how spatial scale and pattern could affect our results, we computed semivariograms for each trait and environmental variable at each site. Data were z-transformed before analysis. Plots of these semivariogram scores (gamma) as a function of distance can be summarized and compared among sites. To analyze trends within each site, we ran a linear fit on each trait. If the semivariogram score reached an asymptotic value at a distance less than the maximum length dimension of a transect (sill reached at range within study extent), then we were confident that the maximum spatial scale of the analysis captured the maximum natural variation available in the habitat type. Spatial structure was evident within most sites for each measured trait. There was a significant positive linear trend in semivariogram scores as a function of distance for LDMC at 3157 m (Pfeiler) and 3537 m (Baldy), leaf area at 3157 m (Pfeiler) and 3357 m (Painter Boy Mine), height at 3157 m (Pfeiler) and 3357 m (Painter Boy) and SLA at 3157 m (Pfeiler). The level of variation generally increased as elevation decreased for area and showed no distinctive trend for height, leaf area or SLA.

These analyses suggest spatial structure in the dataset at both <20 cm and >12 m distances. At the lowest elevation and second highest elevation sites, there was no autocorrelation across the spatial scales measured. This result could reflect a true lack of spatial structure or a sampling scale too coarse to capture the variation. In addition, for traits with a linear relationship, there was no asymptote reached over the spatial scale measured, potentially reflecting spatial structure at distances greater than our

study's extent. Therefore, future study over a broader spatial scale is needed to fully capture the range of heterogeneity present in these communities. However, we do see linear trends in semivariograms for both mid-elevation sites. The high levels of moisture and moderate temperatures at these sites may allow for greater niche space availability. Overall, the measured spatial structure indicates that there is spatial trait variation that may be important in determining local species interactions.

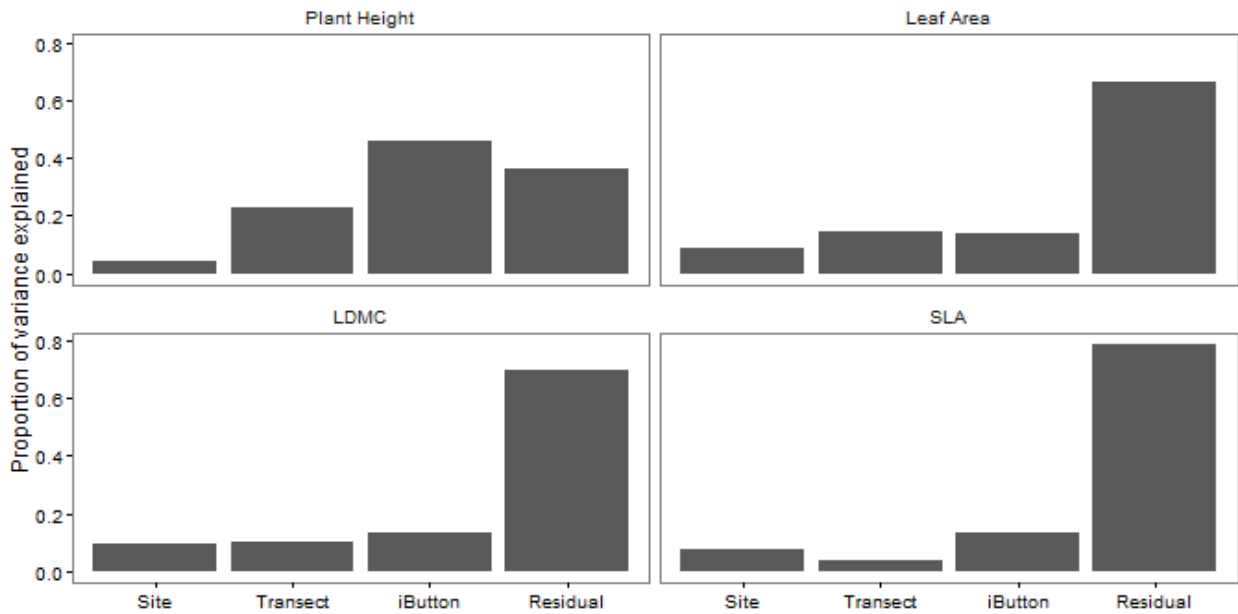


Figure A5. Variance partitioning analysis for each trait.

We examined the amount of variance in each trait captured by each spatial scale used in other analyses. For most traits, within-sampling point (residual) variance accounted for >50% of the variation in the trait. For plant height, between-sampling point variance was largest, explaining 46% of the measured variation.