Distance, geology, and precipitation determine **taxonomic** and **phylogenetic** differences between alpine plant communities.

Scan for a digital copy of the poster and more info on the project!

Introduction

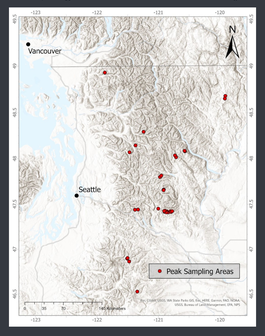
Alpine plant communities are unique in their diversity and persistence through extreme conditions.

Ongoing question of to what degree the community is determined by spatial patterns or random processes (Malanson et al., 2015), and whether this is mediated by phylogeny (Jin et al., 2015; Marx et al., 2017).

At the mountain-range scale, we elucidated patterns of geography, geology, and climate on dissimilarity between alpine plant communities.

Figure 1. Example of sampling design for two peaks, identifying all accessible plants above the continuous treeline.

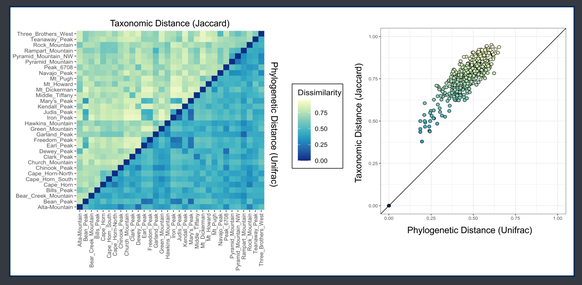
Figure 2. Map of all Cascades peaks sampling areas included in the study



Methodology

- Vascular plant communities of 32 alpine areas across the Cascade Mountain Range of Washington were sampled.
- Taxonomic and Phylogenetic Distance between peaks calculated using Jaccard and Unifrac distance measures.
- Mantel test used to determine spatial autocorrelation
- PERMANOVA model tested relationships of *geographic*, *geologic*, and *climatic* variables to distance measures
- NMDS visualized these relationships in reduced dimensions

Figure 3. Heatmap and scatter plot comparisons of Jaccard and Unifrac distance measures showing correlations in patterns between peaks but overall smaller phylogenetic distances.



Results

Mantel Test

	Mantel r
Jaccard	0.410**
Unifrac	0.245***

Table 1 Results from Mantel tests of community dissimilarity against geographic distance.

Tables 2 &3. Final PERMANOVA models from top-down model selection of best geographic, geologic, and climatic variables and covariates. Each test used 100,000 permutations and asterisks correspond to significance of F-statistic results (*:<0.5, **:<0.01, ***:<0.0001).

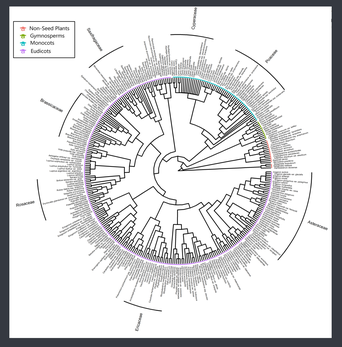
PERMANOVA (Tax.)

	df	SS	R^2
Latitude	1	0.572	0.062**
Longitude	1	0.970	0.104***
Year	2	0.929	0.100***
DaysIntoFS	1	0.746	0.080***
Elevation	1	0.351	0.038*
Lithology	4	1.661	0.179***
Precipitation Seasonality	1	0.355	0.038*
Residual	20	3.708	0.399
Total	**31**	**9.291**	

PERMANOVA (Phylo.)

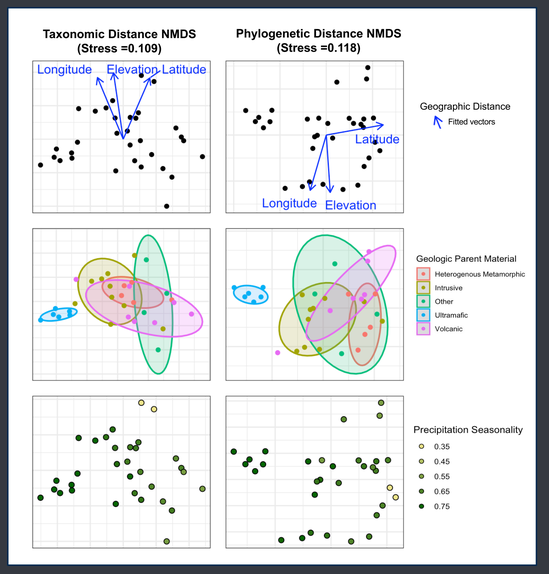
	df	SS	R^2
Latitude	1	0.216	0.062**
Longitude	1	0.365	0.105***
Year	2	0.392	0.113***
DaysIntoFS	1	0.371	0.107***
Elevation	1	0.140	0.040*
Lithology	4	0.688	0.198***
Precipitation Seasonality	1	0.141	0.041**
Residual	20	1.161	0.334
Total	**31**	**3.474**	

Figure 4. Phylogenetic tree of all project taxa with major groups and common families labeled



Distance, date sampled, elevation, geologic parent material, and precipitation variability predicted both plant community dissimilarity measures

Figure 5. NMDS plots of taxonomic and phylogenetic distances between alpine plant communities with the most significant predictors (from PERMANOVA results) overlaid. Each point represents a peak, and its distance to every other peak is a 2-dimensional representation of the plant community's distance to every other community.



Discussion

Alpine plant communities form through distinct conditions in geology and climate through space, which is valuable for looking back into their evolutionary histories and forward to their responses to climate change.

References

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Drivers of alpine plant community dissimilarity in the Cascade Mountain Range.

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