Working Title: From leaf to biome: multi-scale variability in plant-herbivore interactions

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Abstract: Interactions between plants and herbivores are highly variable at multiple spatial scales: from leaf to leaf within a single plant, from plant to plant within a population, from population-to-population within a species, and across plant species. However, little is known about whether or how this variability is linked across scales. HerbVar is a global network of over 200 biologists dedicated to studying variability in plant-herbivore interactions. We have conducted standardized surveys of herbivore damage in over 790 plant populations representing 503 species from 135 families. For most plant populations, we surveyed herbivore damage on at least 10 individual leaves on 60 individual plants. Here, we leverage this large dataset to ask two questions related to interaction variability across different scales: 1) What is the relative amount of variation in herbivore damage explained across different scales: among leaves, plants, populations, and species? 2) Does variation scale from sub-individual to population to species? 3) Which plant traits are associated with higher of sub-individual variation in leaf damage? Our preliminary results suggest that over half the total variation in herbivore damage (68%) is explained by sub-individual (leaf-to-leaf) variation within individual plants, with much smaller amounts attributed to variation across individual plants (19%), across plant populations (12%) or across species (<0.01%). We also found strong linkages across scales, such that plants with high leaf-to-leaf variability also experienced high plant-to-plant variability across populations. However, variation across populations within species was largely independent of variation at smaller scales. Finally, we found that the amount of sub-individual variation increased with the number of leaves per plant and decreased with leaf size. These results challenge the common assumption that differences across species should be larger than differences at smaller (within-individual) scales, and emphasize the potential for processes that predict variability at very small scales to shape broader patterns in ecological communities.

Data: Phase I HV Data

Response variables: raw proportion leaf damage, leaf gini, plant gini, population gini
Predictor variables: scale of observation, plant size, leaf size, latitude, biome

Authorship model: Traditional Plus. The lead author invites known individuals with value for the particular paper, plus a few people chosen from the HerbVar database as a good match for this project.

Timeline
Conception and planning: 2023
Data processing and analyses: Oct 2023 – Dec 2024
Writing: Jan – June 2025
Submission: Summer 2025