Species Boundaries in Two Northern California Monkeyflowers

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Introduction:

- Recently diverged taxa maintain species boundaries via one or more reproductive barriers [1].
- Annual wildflowers Mimulus guttatus and Mimulus glaucescens overlap in range and interbreed in the greenhouse but rarely hybridize in nature [2].
- Previous research examined 14 potential reproductive barriers but did not demonstrate complete reproductive isolation [3, 4].
- Thus, either unmeasured reproductive barriers exist, or species boundaries are semipermeable between the two taxa.

Study Taxa:

Mimulus guttatus & M. glaucescens are closely-related monkeyflower species. The species have nearly identical floral morphology and are only distinguishable by vegetative traits [5].

Mimulus guttatus:

- M. guttatus possesses two bracts subtending each inflorescence.
- M. guttatus possesses trichomes on leaves and bracts.

Mimulus glaucescens:

- M. glaucescens possesses one single, circular bract subtending each inflorescence.
- Trichomes are absent on the bracts of M. glaucescens.

Methods:

Morphological Analysis:

- We conducted morphological measurements on greenhouse-grown M. guttatus, M. glaucescens, F1 hybrid, F2 hybrid, and backcrossed individuals.
- Measurements included trichome density (trichomes per 0.25cm²) and bract shape (bract width / bract length).

Statistical Analysis:

- We evaluated differences in morphology between M. guttatus, M. glaucescens, hybrids, and backcrosses using Analysis of Variance (ANOVA).

Genetic Analysis:

- We collected M. guttatus and M. glaucescens bract tissue samples from individuals located in Butte Creek Canyon, a known sympatric zone for the two species.
- We then extracted DNA from bract tissues and sent the samples to the UC Davis Genome center for whole-genome sequencing (2x coverage).
- Using fastSTRUCTURE [6], we analyzed SNPs for evidence of genetic admixture. We used DISTRACT [7] to visualize results.

Significance:

- In contrast to the strong and often redundant reproductive barriers in other Mimulus sister taxa [8], the species boundaries between Mimulus guttatus and Mimulus glaucescens are either much weaker or perhaps incomplete [8].
- F1 and F2 hybrids possess intermediate morphological traits compared to their parent species, suggesting quantitative inheritance. Still, field identification of hybrids is difficult.
- Preliminary genetic data suggests that genetic introgression is not occurring. More genetic analysis with a larger sample size and additional sympatric populations would strengthen these findings.

Results:

Morphological measurements suggest that hybrids and backcrosses possess intermediate traits between M. guttatus and M. glaucescens.

- Fig. 3: Mean trichome density of Mimulus species, hybrids, and backcrosses. Bars represent 95% confidence intervals.
- Fig. 4: Mean bract shape of Mimulus species, hybrids, and backcrosses. Bars represent 95% confidence intervals.

Preliminary fastSTRUCTURE results suggest that little, if any, genetic admixture has occurred between M. guttatus and M. glaucescens in Butte Creek Canyon, CA.

- Fig. 5: Preliminary fastSTRUCTURE results from six M. guttatus and two M. glaucescens individuals collected from four sympatric populations in Butte Creek Canyon, CA. Each column represents one Mimulus individual, symbolized by the estimated proportions of M. guttatus and M. glaucescens genetic ancestry present in each individual. M. guttatus ancestry (blue) and M. glaucescens ancestry (orange) are clearly separated, with no genetically admixed individuals identified in this study.

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