Phylogenetic relationships, mating systems and
population structure in *Lupinus* (Leguminosae)

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ABSTRACT

Lupinus (Leguminosae) comprises a large genus of plants distributed throughout North America, South America, and the Mediterranean region of Africa and Eurasia. Species exhibit a wide range of morphological variation, with mating systems that vary from selfing to outcrossing. The evolution of the genus was examined from phylogenetic and population level perspectives, with a particular focus on the *L. microcarpus* species complex. Phylogenetic relationships were estimated using three regions of non-coding chloroplast DNA (*trn*S-*trn*G, *trn*T-*trn*L, *trn*L intron). The resulting phylogeny yields insights into the origins of several major groups of *Lupinus* and evidence for parallel radiations in the New World. Comparative analysis of floral display in *Lupinus* indicates that banner spot color change is non-randomly associated with multiple inflorescences, upright growth habit, and large total display size, consistent with the hypothesis that color change has evolved as an adaptation to maintain the benefits of large floral display. While these results are non-significant after corrections for multiple comparisons and are sensitive to model assumptions for the rate and variance of character evolution, ancestral state reconstructions indicate that color change has evolved independently at least once in the *L. microcarpus* species complex. Population structure and mating system estimates for *L. microcarpus* were obtained using novel microsatellite markers developed for the *Microcarpi*. Patterns of genetic differentiation among two sympatric varieties of *L. microcarpus* (var. *horizontalis*, var. *densiflorus*) across a range of hierarchical spatial levels indicate that sub-specific taxa may actually comprise reproductively isolated species with high rates of selfing and substantial population subdivision. Estimates of mating systems in var. *horizontalis* using field-collected progeny arrays and microsatellite markers indicate that outcrossing rates are generally low, while concordance between single-generation and equilibrium measures of inbreeding suggest that differences in mating systems between populations are stable. In addition, selfed progeny of var. *horizontalis* have lower rates of survival compared to outcrossed progeny due to inbreeding depression, whereas fecundity of survivors is reduced by the deleterious effects of genetic drift within subdivided populations. These results provide a phylogenetic and population genetic framework for understanding the evolution of species and mating systems in *Lupinus*.