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EDEN Undergraduate Internship

Visit Narrative

During this fellowship I investigated how a macro-morphological change may persist and possibly be selected for at the population level. To answer this, I studied the spurred Colorado columbine, *Aquilegia coerulea*, and a homeotic mutant, *A. coerulea* var. *daileyae*, which is found at about 30% frequency in one population in Reynolds Park, Colorado. The wild type flower has five sepals and five petals, and each petal consists of a blade and tubular spur with a nectar reward for pollinators. In the homeotic mutant, the five petals are replaced with sepals (totaling 10 sepals). This mutant is caused by a recessive, non-functional allele of the floral identity gene *AP3-3*. The purpose of my visit was to conduct a mix of field and lab work to determine (a) if the change in phenotype affects floral visitors (pollinators or herbivores), and (b) if random mating occurs between the two morphologies.

The lack of petals on var. *daileyae* eliminates a nectar reward and thus might influence visitation by nectar-gathering animals. To determine if pollinators discriminate between wild type and mutant flowers, my advisor, Dr. Scott Hodges, and I set up video cameras in the field to record visitations. We captured video of hawkmoths probing both var. *daileyae* and wild type flowers. When a hawkmoth visits a wild type, it probes with its proboscis down the nectar spur, causing its body to contact the flower's reproductive organs. Because the homeotic mutant lacks these spurs, the hawkmoth's body does not come in contact with the reproductive organs. Thus, hawkmoths may cause mating primarily among wild type plants. We also observed bumblebees visiting both morphologies with no obvious preference. Bumblebees were collecting pollen and thus likely preferred male-phase flowers, which may decrease their effectiveness as a

pollinator. Taken together, I predict that wild type plants will have a higher outcrossing rate than var. *daileyae*, and that wild type plants may be more likely to mate assortatively. Using microsatellites, I will test these predictions this fall by conducting a paternity analysis and measuring out-crossing rates.

To assess mating patterns and measure the reproductive fitness of the two morphs, we used a triangulation system to map the position of 427 flowering plants in the population. This allowed us to relocate plants when fruits were ripe while still knowing each plant's flower morphology. When we collected seed, we also recorded if a flower produced a fruit, was eaten, or had been aborted. A particularly exciting outcome of this study is that we found a significant fitness advantage for the var. *daileyae* phenotype. Using fruit production as a proxy for fitness, we found that var. *daileyae* produced significantly more fruits than wild type ($\chi^2 = 10.826$, $p = 0.001$, $df = 1$). We also found that var. *daileyae* had significantly less herbivory than the wild type ($\chi^2 = 5.471$, $p = 0.0193$, $df = 1$). This shows a strong fitness advantage for the homeotic mutant due to reduced herbivory.