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Proposal Title

Investigating introgression in arid-adapted oaks

Proposal Description

Oaks are among the most widespread and diverse plant groups in the Northern Hemisphere. Whereas the term "oak" typically evokes an image of large trees, many oaks grow as shrubs. Both tree and shrub oaks play important ecological roles through providing resources to wildlife, as well as regulating water and soil quality. Many oak species engage in introgression, defined as the exchange of genetic material between species. Introgression occurs via hybridization, which is the creation of offspring with intermediate qualities from two different species. If the offspring retains the ability to reproduce with either of the parental species, genetic material from one species can enter into the other species as a result. The sharing of genetic material and prevalence of intermediate forms can complicate the determination of boundaries between oak species.

I study a group of seven oaks distributed across the southwestern United States. Some of these oaks present as trees, others as shrubs, and a few as both depending on environmental conditions; all of them share adaptations to the hot and arid climate. The members of the southwestern group engage in introgression, with one of its members, Gambel oak (Quercus gambelii), known to hybridize with all six other members at various parts of its range. I plan to apply modern genomic techniques to investigate the extent and impact of introgression in the group. I expect that introgression may be present in most, if not all, species pairs, which could challenge the current delineation of the species. However, the signal of introgression patterns should vary across different traits. For example, introgression should be rare or absent at traits that are specific to a species' niche, such as adaptation to a certain soil composition. In contrast, introgression should be more common in traits that are beneficial for many species or in diverse environmental conditions.

Since introgression patterns may correlate with the physical proximity of involved species and local environmental factors, my sampling strategy considers populations of each oak species in isolation from all the others, as well as sites hosting populations of multiple oak species that could potentially undergo introgression. The samples I collect from isolated sites serve as a baseline expectation to compare with samples from mixed sites. I have previously collected samples of all seven focal species across isolated and mixed field sites in Arizona, New Mexico, Utah, Texas, and Oklahoma.

Improving depth of sampling is also important for increasing the power of population genetic analyses to detect introgression patterns, especially at mixed sites. I hope to use the $500 travel grant to return to some mixed sites that I have visited previously in order to increase my depth of sampling, as well as travel to additional novel field sites to increase geographic coverage. Previous sites I hope to revisit include: in Arizona, Mt. Ord in Tonto National Forest; and in New Mexico, the Silver City district of Gila National Forest. I am further interested in two new locations in Utah: the Zion Canyon area of Zion National Park, and the Arch Canyon region of Bears Ears National Monument. From each site I will collect leaf tissue to transport back to Washington State University for laboratory analyses. The travel is tentatively planned for April or May of 2024. Since some of my oaks are deciduous and only carry leaves for part of the year, more specific dates must be determined closer to the onset of leafing season.

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