

## Exploring Cytonuclear Interactions and Their Phenotypic Outcomes in a Poplar Hybrid Zone

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Nuclear and cytoplasmic genomes, including both chloroplast and mitochondrial genomes, interact synergistically to maintain essential functions across plant species. The maintenance of these functions largely depends on the coevolution of cytoplasmic genes with co-functioning nuclear genes, including mitochondrial-nuclear (mt-N) and chloroplast-nuclear genes (cp-N). Thus, cytonuclear interactions, or the interplay between mt-N/cp-N genes with cytoplasmic genes, have likely coevolved at the species level. However, interspecific hybridization can influence co-evolved cytonuclear interactions, with impacts to phenotypic trait variation important to adaptation. *Populus* trees provide an excellent model to study cytonuclear interactions due to its weak barriers to reproduction and extensive hybridization in nature. In this study, we leveraged whole genome resequencing of 576 *Populus* trees across seven latitudinally distributed transects spanning the natural hybrid zone between *Populus trichocarpa* and *P. balsamifera*. We used genotypes sourced from across the hybrid zone transplanted to three replicated common garden environments to ask how cytonuclear interactions contribute to phenotypic variability across novel environments. We estimated admixture proportions from nuclear data and assigned chloroplast identity using phylogenetic analyses. We first tested the role of climate to changes in ancestry for nuclear genes, cp-N genes, and chloroplast genes across the hybrid zone. Preliminary clinal analysis reveals similar clinal variation, but different centers and widths of clines across gene groups, suggesting fine-scale selection may play a role influencing cytonuclear interactions across the hybrid zone. Using our common garden experiments, we assessed the role cytonuclear interactions to phenotypic traits important to adaptation. We found evidence that chlorophyll content was influenced by varying cytonuclear interactions. These findings emphasize the need for further evaluation of the role cytonuclear interactions where species hybridize to understand how these interactions may influence phenotypic outcomes needed to predict fitness across novel environments.