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Background and Introduction

Valley Oak (Quercus lobata) is an economically, ecologically, and culturally valuable resource (Sork et. al 2016). Oak trees such as Valley Oak are used as inexpensive, renewable raw material for hardwood lumber (Luppold and Bumgardner 2013) found throughout hunting and range territories (Standiford and Howitt 1993; Kroeger et al. 2010). Ecologically, Valley Oak is also a source of nutrition for wildlife in those regions (Dahlgren et al. 1997; Herman et al. 2003). Oak ecosystems stabilize the habitats of aquatic and terrestrial animals (Dosskey et al. 1997; Kroeger et al. 2010). Culturally, oak trees are used to beautify modern civilized areas and as a source of food by native cultures (Pavlik et al. 2006; Anderson et al. 2013).

All of these are sound reasons to invest in the maintenance of oak ecosystems. To preserve their ecosystems, oaks are planted by selective harvesting and by their own natural reproduction. However, a problem with using selective harvesting is how to do this locally taking rapid climate change into consideration (Spittlehouse and Stewart 2004; Millar et al. 2007; Aitken and Whitlock 2013; Aitken et al. 2008). Climates around the world are quickly changing due to industrialization, and the climate change may disrupt the health of oak ecosystems. To prevent this, researchers wish to better understand the genes that control the oak’s adaptation to climate change. This would allow genetic engineers to design seeds that are resistant to extremes in climate change (Sork et al 2016). To make this easier, researchers have published drafts of the nuclear and chloroplast genomes of Quercus lobata (e.g., Derory et al. 2006; Gugger et al. 2016a; Spiess et al. 2012; Sork et al. 2016).

Reference genomes technically allow genetic scientists design reliable gene models and understand the evolution of the species (Sork et al 2016). For the sake of the preservation of oak ecosystems, such a reference genome of Quercus lobata would facilitate its annotation for genes that specialize in the plant’s adaptation to climate change (Sork et al 2016). Although past papers like Sork et al. 2016 have published drafts of the annotated reference genome for Quercus lobata, revisions and extensions to the annotations must be made. This paper suggests annotations to specific loci from that those drafts. To annotate genomes, the loci ranges were analyzed using Apollo genome-annotation software. Peptide sequences encoded in these genes will be analyzed by first finding homologous peptide sequences using NCBI’s Protein BLAST. The homologous sequences were then used to construct phylogenetic trees and Multiple Sequence Alignment using Clustal Omega. Lastly, the protein structures of homologous peptide sequences were compared using SWISS-MODEL. Combined all these tools allowed for the inference of the function of the peptide sequence found in Apollo.

Works Cited

Aitken, Sally N., and Michael C. Whitlock. “Assisted Gene Flow to Facilitate Local Adaptation to Climate Change.” *Annual Review of Ecology, Evolution, and Systematics*, vol. 44, no. 1, 2013, pp. 367–388., doi:10.1146/annurev-ecolsys-110512-135747.

Aitken, Sally N., et al. “Adaptation, Migration or Extirpation: Climate Change Outcomes for Tree Populations.” *Evolutionary Applications*, vol. 1, no. 1, 2008, pp. 95–111., doi:10.1111/j.1752-4571.2007.00013.x.

Anderson, Kat. *Tending the Wild: Native American Knowledge and the Management of California's Natural Resources*. University of California Press, 2013.

DAHLGREN, R.A., and X. HUANG. “Oak Tree and Grazing Impacts on Soil Properties and Nutrients in a California Oak Woodland.” *SpringerLink*, Kluwer Academic Publishers, link.springer.com/article/10.1023/A:1005812621312.

Derory, Jérémy, et al. “Transcriptome Analysis of Bud Burst in Sessile Oak (Quercus Petraea).” *New Phytologist*, vol. 170, no. 4, 2006, pp. 723–738., doi:10.1111/j.1469-8137.2006.01721.x.

Dosskey, Michael G., et al. “Riparian Buffers for Agricultural Land.” *Iowa State University Digital Repository*, lib.dr.iastate.edu/for\_pubs/9/?utm\_source=lib.dr.iastate.edu%2Ffor\_pubs%2F9.

Gugger, Paul F., et al. “Association of Transcriptome-Wide Sequence Variation with Climate Gradients in Valley Oak (Quercus Lobata).” *Tree Genetics & Genomes*, vol. 12, no. 2, 2016, doi:10.1007/s11295-016-0975-1.

Herman, et al. “NITROGEN DYNAMICS IN AN ANNUAL GRASSLAND: OAK CANOPY, CLIMATE, AND MICROBIAL POPULATION EFFECTS, Ecological Applications.” *DeepDyve*, Ecological Society of America, 1 June 2003, www.deepdyve.com/lp/ecological-society-of-america/nitrogen-dynamics-in-an-annual-grassland-oak-canopy-climate-and-IXZ8SWzCXG.

Kroeger. “An Economic Analysis of the Benefits of Habitat Conservation on California Rangelands.” *California Rangeland Conservation Coalition*, www.carangeland.org/images/An\_Economic\_Analysis\_of\_the\_Benefits\_of\_Habitat\_Conservati\_3\_.pdf.

Luppold, William G., and Matthew S. Bumgardner. “Factors Influencing Changes in U.S. Hardwood Log and Lumber Exports from 1990 to 2011.” *BioResources*, vol. 8, no. 2, June 2013, doi:10.15376/biores.8.2.1615-1624.

Millar, Constance I., et al. “Climate Change And Forests Of The Future: Managing In The Face Of Uncertainty.” *Ecological Applications*, vol. 17, no. 8, 2007, pp. 2145–2151., doi:10.1890/06-1715.1.

Millar, Constance I., et al. “Climate Change And Forests Of The Future: Managing In The Face Of Uncertainty.” *Ecological Applications*, vol. 17, no. 8, 2007, pp. 2145–2151., doi:10.1890/06-1715.1.

Pavlik, Bruce M. *Oaks of California*. Cachuma Press, 2006.

Sork, V. L., et al. “First Draft Assembly and Annotation of the Genome of a California Endemic Oak Quercus Lobata Nee (Fagaceae).” *G3&Amp;#58; Genes|Genomes|Genetics*, Dec. 2016, doi:10.1534/g3.116.030411.

Spittlehouse, D & B Stewart, Robert. (2003). Adaptation to climate change in forest management. British Columbia Journal of Ecosystems and Management. 4.

Spiess, Nadine, et al. “Ecophysiological and Transcriptomic Responses of Oak (Quercus Robur) to Long-Term Drought Exposure and Rewatering.” *Environmental and Experimental Botany*, vol. 77, 2012, pp. 117–126., doi:10.1016/j.envexpbot.2011.11.010.

Standiford, Richard B., and Richard E. Howitt. “Multiple Use Management of California's Hardwood Rangelands.” *Journal of Range Management*, vol. 46, no. 2, 1993, p. 176., doi:10.2307/4002277.