Native to Where? California's Native Trees and Their Use in the Urban Environment

Britton Fund Research Report

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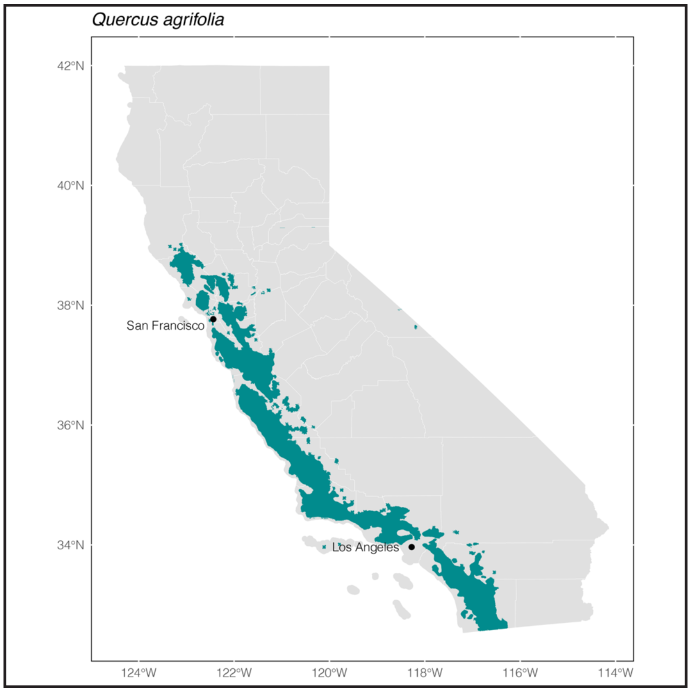

Figure 1. **Digitized range for the coast live oak, *Quercus agrifolia*.**

California is one of the world's 33 biodiversity hotspots, with over five thousand different species growing across the diverse climates, topography, and geology within the state (Burge et al., 2016; Jepson Flora Project, 2022; Myers et al., 2000). Of those five thousand native species, 95 are trees. California's urban forests are made up of over 1,400 species, some native to California, and many from all over the world (Love et al., 2022). Recently, there is a growing push to plant mostly or all native species in California's urban forests because they are believed to bring more benefits to urban forests than non-native trees. However, the scale at which a species is defined as native is often inconsistent, and the assumption that native trees bring more benefits is flawed. Almost no species is native across all the diverse environments present in California, but rather restricted to ranges determined by a variety of factors such as climate, topography, and evolutionary history. In our research, partly supported by the Britton Fund, we determined the native ranges of each of California's native tree species and created city-specific native species lists for each city in California.

To make range maps for each native tree species across California, we first determined that there are 95 species of trees native to the state. For a large, woody plant species to be defined as a tree, over 90% of the total known or surveyed individuals in the species must reach a mature height of over 20 feet and have a single, dominant trunk more than 15 centimeters in diameter at 1.5 meters above the ground. Shrubs are smaller and shorter than trees and often have many small, bark-covered stems rising from near ground level. There are many California plants (e.g. *Ceanothus* and *Arctostaphylos*) where individuals occasionally satisfy the definition of a tree, including large, iconic shrubs like toyon (*Heteromeles arbutifolia*), islay (*Prunus ilicifolia*), smoke tree (*Psorothamnus spinosus*), and elderberry (*Sambucus mexicana*). We excluded these species from our list.

For each tree species, we researched the native range and used maps and data points from previous botanical surveys, historical books and research papers, and occurrence records from the Global Biodiversity Information Facility (GBIF) to create a digital native range map (Figure 1) for each species (GBIF, 2022; Griffin & Critchfield, 1970; Hauser et al., 2017; Kauffmann, 2013; Little, 1976, 1971). Using these species range maps and the urban boundaries for census-designated places in California, we used spatial analysis to find where each range overlapped each urban boundary. From that process, we created city-specific native tree species lists for 1173 census-designated places in California (Figure 2). We then used data from the California Urban Forest Inventory (CUFI) to assess what percent of each inventoried city's urban forests is made up of native trees and species (Love et al., 2022).

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To make these data available to the public, we created a web map. On the web map's layers tab, users can access a heat map of the number of trees native across California, the individual range of each of the 95 tree species, the urban boundaries for each census-designated place in California, and the number of species native to each place. Individual ranges of trees can be accessed, turned on and off for viewing, and selected using either the "Selectable Species Ranges" layer, or the list of ranges beneath the tree icon. Species lists can be accessed by opening the attribute table associated with the layer "California Cities and Their Native Tree Species" (Figure 2, Figure 3). This table can be accessed by the three dots next to the layer name within the layer tab and selecting "View Attribute Table." When the layer is turned on for view, you can also click on any urban area, and the associated species list will pop up. With this combination of data, in addition to accessing city specific native species lists, users can see specifically where within an urban boundary a species is native. If the city has data included in the CUFI, selecting the city boundary will also show statistics on the percentage of trees and species in the urban forest that are native (Love et al., 2022).

With recent trends promoting native or only native plantings in urban environments, we hope these data can help managers who are looking to plant natives choose species that are native to their specific city rather than state. Compared to the 1,400 species of trees planted in California's urban forests, 95 native trees is a small subset of species, with even fewer species native to each city (Love et al., 2022). Of those 95 species, many native trees are inappropriate for urban environments, either because they are riparian species that need a lot of water, or just aren't adapted for the challenges of growing in an urban setting. With so few native options compared to non-natives, it can be unwise to plant only native species for our urban environments.

In an urban forest, having a diverse set of species is key to having healthy forest that provides ecosystem services, because higher species diversity minimizes the risk of tree loss to individual threats like pests, diseases, or climate change (Huff et al., 2020; Nitschke et al., 2017; Paquette et al., 2021; Raupp et al., 2006; Wood and Dupras, 2020). In addition to increasing the diversity of an urban

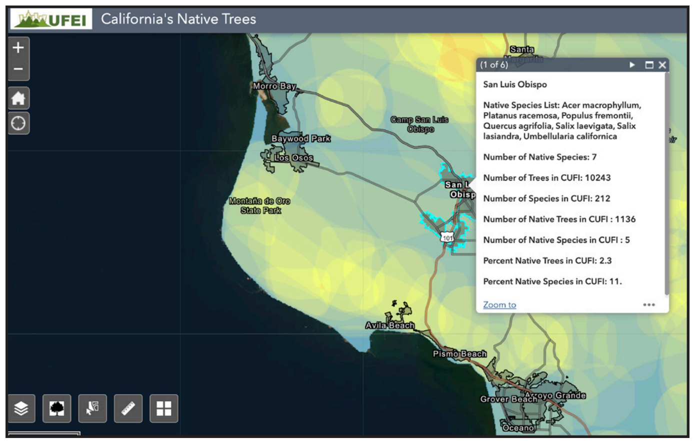

Figure 2. **Example species list for San Luis Obispo, California. We created city-specific native species lists for 1173 census-designated place in California.**

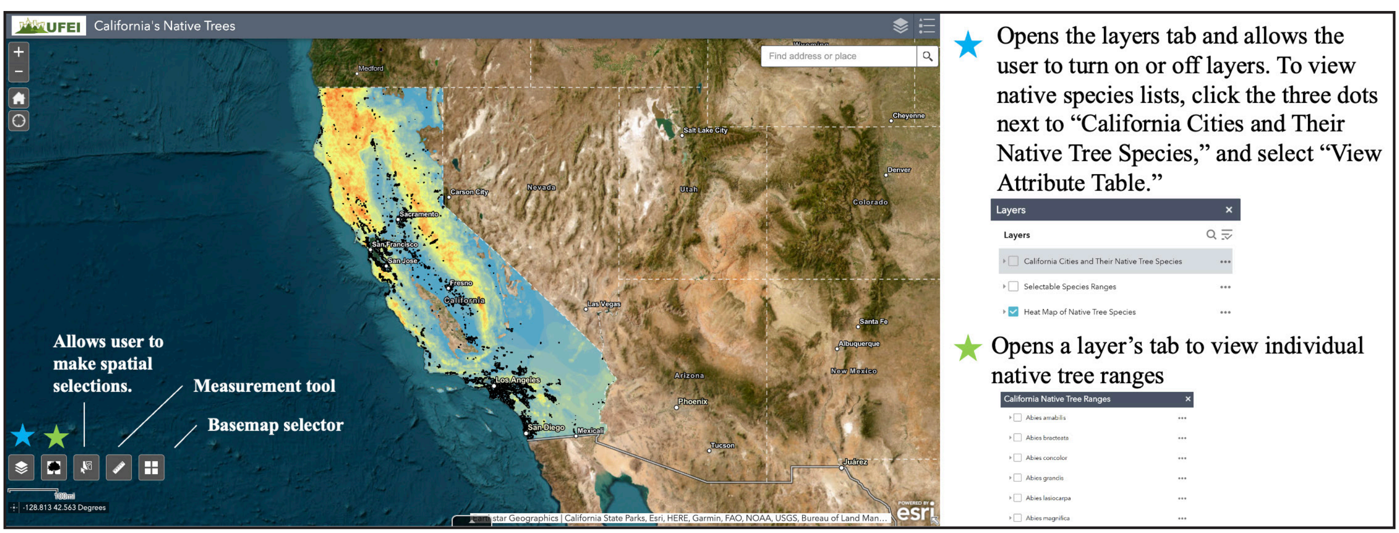

Figure 3. **Guide to using the web application. Users can turn on and off layers, view species lists, and make spatial selections. https://calpoly.maps.arcgis.com/apps/webappviewer/index.html?id=3c4233d842a64e41ac9cf3713848a481**

forest, there are other reasons to plant a non-native tree. The suitability of a tree for an urban environment is dependent on more than just its native or non-native status. When selecting a species, we must consider the climates that species can handle, the amount of water it needs, the hardiness of the species to the urban environment, the weediness of the species, and many other factors. In California, our urban environments are predicted to get hotter and drier due to climate change. Species selected for California's future urban forests should be able to withstand future climatic challenges. Our research shows that there are limited options for planting native trees in California's urban forests. We hope that our work can help inform management goals and species selections for healthy urban forests for California's future.

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REFERENCES

Burge, D.O., J.H. Thorne, S.P. Harrison, B.C. O'Brien, J.P. Rebman, J.R., Shevock, E.R. Alverson, L.K. Hardison, J.D. Rodríguez, S.A. Junak, T.A. Oberbauer, H. Riemann, S.E. Vanderplank, and T. Barry. 2016. Plant diversity and endemism in the California floristic province. *Madroño* 63(2): 3-206. https://doi.org/10.3120/madr-63-02-3-206.1

Global Biodiversity Information Facility. 2022. *GBIF: The Global Biodiversity Information Facility Occurrence Download*. https://www.gbif.org/occurrence/search

Griffin, J. R., and W.B. Critchfield. 1976. *The Distribution of Forest Trees in California*. Pacific Southwest Forest and Range Experiment Station.

Hauser, D.A., A. Keuter, J.D. McVay, A.L. Hipp, and P.S. Manos. 2017. The evolution and diversification of the red oaks of the California Floristic Province (*Quercus* section *Lobatae* , series *Agrifoliae*). American Journal of Botany 104(10): 1581–1595. https://doi.org/10.3732/ajb.1700291

Huff, E., M. Johnson, L. Roman, N. Sonti, C. Pregitzer, L. Campbell, and H. McMillen. 2020. A literature review of resilience in urban forestry. *Arboriculture & Urban Forestry* 46(3): 185–196. https://doi.org/10.48044/jauf.2020.014

Jepson Flora Project. 2022. *Jepson eFlora*. https://ucjeps.berkeley.edu/eflora/

Kauffmann, M.E. 2013. *Conifers of the Pacific Slope: California, Oregon, and Washington* (First edition). Backcountry Press.

Little, E. L., Jr. 1976. *Atlas of United States Trees* (Vol. 1). Department of Agriculture, Forest Service.

Little, E. L., Jr. 1971. *Atlas of United States Trees* (Vol. 1). Department of Agriculture, Forest Service.

Love, N.L.R., V. Nguyen, C. Pawlak, A. Pineda, J.L. Reimer, J.M. Yost, G.A. Fricker, J.D. Ventura, J.M. Doremus, T. Crow, and M.K. Ritter. 2022. Diversity and structure in California's urban forest: What over six million data points tell us about one of the world's largest urban forests. *Urban Forestry & Urban Greening* 74: 127679. https://doi.org/10.1016/j.ufug.2022.127679

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403(6772): 853–858. https://doi.org/10.1038/35002501

Nitschke, C.R., S. Nichols, K. Allen, C. Dobbs, S.J. Livesley, P.J. Baker, and Y. Lynch. 2017. The influence of climate and drought on urban tree growth in southeast Australia and the implications for future growth under climate change. *Landscape and Urban Planning* 167: 275–287. https://doi.org/10.1016/j.landurbplan.2017.06.012

Paquette, A., R. Sousa-Silva, F. Maure, E. Cameron, M. Belluau, and C. Messier. 2021. Praise for diversity: A functional approach to reduce risks in urban forests. *Urban Forestry & Urban Greening* 62: 127157. https://doi.org/10.1016/j.ufug.2021.127157

Raupp, M., A. Cumming, and E. Raupp. 2006. Street tree diversity in eastern North America and its potential for tree loss to exotic borers. *Arboriculture & Urban Forestry* 32(6): 297–304. https://doi.org/10.48044/jauf.2006.038

Wood, S.L.R., and J. Dupras. 2021. Increasing functional diversity of the urban canopy for climate resilience: Potential tradeoffs with ecosystem services? *Urban Forestry & Urban Greening* 58: 126972. https://doi.org/10.1016/j.ufug.2020.126972