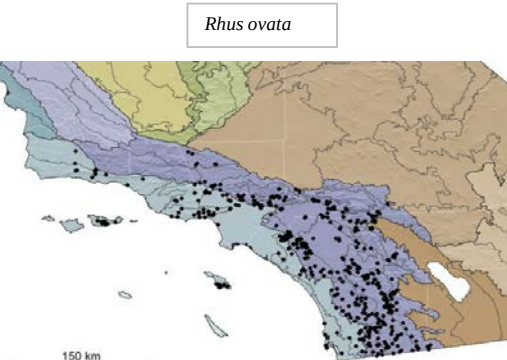
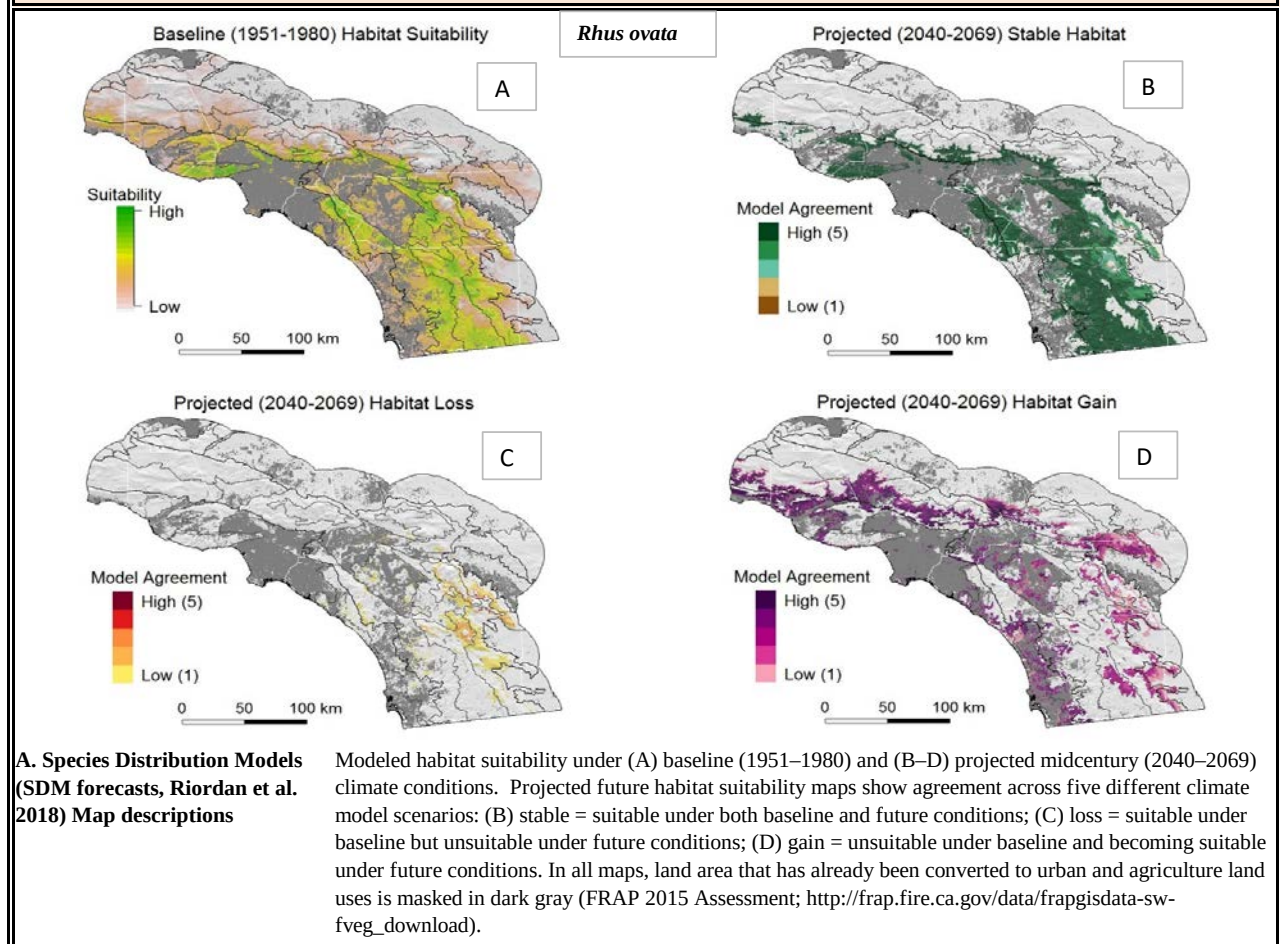


| I. SPECIES                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><i>Rhus ovata</i> S. Watson</b>                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>NRCS CODE:</b><br><b>(RHOV)</b>                                                     | Family: <b>Anacardiaceae</b><br>Order: <b>Sapindales</b><br>Subclass: <b>Rosidae</b><br>Class: <b>Magnoliopsida</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|       |   <p>photos: A. Montalvo</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>A. Subspecific taxa</b>                                                             | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>B. Synonyms</b>                                                                     | <i>R. ovata</i> var. <i>traskiae</i> F. A. Barkley (USDA PLANTS 2016)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>C. Common name</b>                                                                  | sugarbush; sugar bush, occasionally sugar sumac (McMinn 1939)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>D. Taxonomic relationships</b>                                                      | There are over 20 species of <i>Rhus</i> in North America, Europe, and Asia. The most recent phylogenetic analysis using a combination of molecular, morphological, and anatomical traits places <i>R. ovata</i> in section <i>Syphonia</i> with <i>R. integrifolia</i> (Nutt.) Rothr. as its closest relative (Andrés-Hernández et al. 2014).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>E. Related taxa in region</b>                                                       | Two species of <i>Rhus</i> co-occur with sugarbush in California. <i>Rhus integrifolia</i> is the most similar in structure and appearance to sugarbush. It differs in having green sepals and flat, bicolored leaf blades with toothed margins and rounded apex. <i>Rhus aromatica</i> Aiton (= <i>R. trilobata</i> Torrey & Gray) is a low growing shrub with flexible arching branches and compound leaves.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>F. Taxonomic issues</b>                                                             | In areas where <i>R. ovata</i> and <i>R. integrifolia</i> co-occur and hybridize, morphological intermediates may be found making identification difficult (see VI. H. Hybridization potential), but generally the species are easy to tell apart (Lens & Dourley 1981). <i>R. ovata</i> may have some teeth on leaves of mature plants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>G. Other</b>                                                                        | The specific epithet, <i>ovata</i> , refers to the egg-shaped leaves. Plants produce a resin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| II. ECOLOGICAL & EVOLUTIONARY CONSIDERATIONS FOR RESTORATION                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>A. Attribute summary list<br/>(based on referenced responses<br/>in full table)</b> | <div> Taxonomic stability - high<br/> Longevity - long lived (to &gt; 100 yr)<br/> Parity - polycarpic<br/> First reproduction~ ~ 4 to 6 yr<br/> Stress tolerance - moderate to high<br/> Environmental tolerance - moderately broad<br/> Reproduction - facultative seeder after fire<br/> Fragmentation history - recent<br/> Habitat fragmentation - high at low elevations<br/> Distribution - narrow but common </div> <div> Seeds - dormant, long-lived<br/> Seed dispersal distance - short to far<br/> Pollen dispersal - intermediate to far<br/> Breeding system - outcrossed<br/> Population structure - likely low (as in congener)<br/> Adaptive trait variation - possible physiological<br/> Chromosome number - diploid, variation unlikely<br/> Genetic marker polymorphism - likely high (as in congener)<br/> Average total heterozygosity - likely high (as in congener)<br/> Hybridization potential - moderate </div> <div> SDM projected midcentury suitable habitat - predict 85–95 % stable<br/> SDM projected midcentury habitat gain - predict moderate gain with gain &gt;&gt; loss </div> |
| <b>B. Implications for seed transfer (summary)</b>                                     | <i>Rhus ovata</i> is an obligate outcrossing plant with potentially high levels of gene dispersal by both pollen and seeds. There are no obvious local adaptive differences. Issues with inbreeding when populations become small or isolated is likely to be more detrimental than mixing populations from adjacent ecological sections and subsections. The species is predicted to have low exposure (little loss of suitable habitat) to future climate change projected to mid-century. It is also predicted to be more resilient to shortened fire intervals than other co-occurring species of shrubs. This taxon appears to be much more threatened by loss of habitat to development than to climate change. Sugarbush would likely benefit from expansion of wildlife corridors to mitigate effects of fragmentation at lower elevations and by ensuring high genetic diversity of seeds and other plant materials are used in restoration.                                                                                                                                                                  |

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| <b>III. GENERAL</b>                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>C. Geographic range</b>                                                                                                  | Common in southern California from Santa Barbara and Ventura counties and Catalina Is. southward into Baja California; also in Arizona (McMinn 1939, Miller & Wilken 2012).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>D. Distribution in California; ecological section and subsection</b><br>(sensu Goudey & Smith 1994; Cleland et al. 2007) | <p>Map includes validated herbarium records (CCH 2016) as well as occurrence data from CalFlora (2016) and field surveys (Riordan et al. 2018).<br/>Planted occurrences were excluded.</p> <p>Legend has Ecological Sections;<br/>black lines are subsections.</p> <p>Ecological Section/subsection :<br/>Southern California Mountains and Valleys<br/>M262B: a-p (western, low elevation of h)<br/>Southern California Coast 261B: a-c,e-j<br/>Mojave Desert 322A: g (bordering M262B)<br/>Colorado Desert 322C: a (bordering M262B)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>E. Life history, life form</b>                                                                                           | Polycarpic, evergreen woody shrub or small tree. Long-lived, to over 100 yr (Sawyer et al. 2009).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>F. Distinguishing traits</b>                                                                                             | Tall, and wide woody shrub (or small tree) 2 to 5 m tall and often as wide, with stout twigs, reddish when young. The large 3 to 8 cm long leaves are broadly ovate to broadly elliptic, leathery, glabrous, alternate, petiolate, and spirally arranged; leaf tips are acute to acuminate; leaf margins in mature plants are entire, the blade is somewhat folded at the midrib with edges curving upward. The many, clustered (<1 cm wide) white to pale pinkish flowers have reddish sepals with ciliate margins in branched inflorescences at the tips of current season branches. Flowers have 5 sepals and petals and are often male sterile. Fruit is a red, dry, glandular hairy, flattened drupe, producing a single seed surrounded by a stony endocarp (nutlet). Plants produce resin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>G. Root system, rhizomes, stolons, etc.</b>                                                                              | Branched tap root. Lateral spread of roots is expected to be at least to the edge of the canopy of these wide shrubs. In sand dunes, the close relative <i>R. integrifolia</i> was found to have a tap root with long lateral branches extending 10 feet beyond the canopy (Purer 1936).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>H. Rooting depth</b>                                                                                                     | No reports on root depth found, but plants put much effort into root growth during their first few years, suggesting roots grow deep (A. Montalvo pers. obs.). Poole & Miller (1975) concluded that <i>R. ovata</i> must be deep-rooted based on relatively high water potentials maintained through the dry season. The related <i>Malosma laurina</i> and <i>Rhus glabra</i> can produce roots over 6 m deep (DeSouza et al. 1986, Canadell 1996). Along a road cut, <i>Malosma</i> roots were 13.2 m deep.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>IV. HABITAT</b>                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>A. Vegetation alliances, associations</b><br>(sensu Sawyer et al. 2009)                                                  | <p>Sugarbush is a member of many chaparral and coastal sage scrub alliances and associations and has often been overlooked as a dominant species (Sawyer et al. 2009). The <i>Rhus ovata</i> alliance (membership rule &gt; 30% relative cover) includes the following associations: <i>Rhus ovata</i>–<i>Salvia leucophylla</i>–<i>Artemisia californica</i> scrub and <i>Rhus ovata</i>–<i>Zisiphus parryi</i> scrub. Toyon is also a significant associate or co-dominate in the following shubland and woodland plant communities (Sawyer et al. 2009):</p> <p>Woodlands: <i>Prosopis glandulosa</i>/<i>Rhus ovata</i> (upper desert spring) association; <i>Acacia greggii</i> alliance</p> <p>Shrublands: <i>Adenostoma fasciculatum</i>–<i>Salvia apiana</i> alliance; <i>Adenostoma fasciculatum</i>–<i>Salvia mellifera</i>–<i>Rhus ovata</i> association; <i>Arctostaphylos glandulosa</i> alliance; <i>Artemisia californica</i>–<i>Eriogonum fasciculatum</i> alliance; <i>Ceanothus crassifolius</i> alliance especially the <i>Ceanothus crassifolius</i>–<i>Adenostoma fasciculatum</i>–<i>Rhus ovata</i> association; <i>Ceanothus cuneatus</i> alliance; <i>Ceanothus perplexans</i> alliance; <i>Ceanothus oliganthus</i> alliance; <i>Ceanothus oliganthus</i>–<i>Heteomeles arbutifolia</i>–<i>Rhus ovata</i> association; <i>Ceanothus spinosus</i> alliance; <i>Eriodictyon crassifolium</i> alliance; <i>Eriogonum fasciculatum</i> alliance; <i>Heteromeles arbutifolia</i> alliance; <i>Keckiella antirrhinoides</i> alliance; <i>Lepidospartum squamatum</i> alliance; <i>Malacothamnus fasciculatus</i> alliance; <i>Malosma laurina</i> alliance; <i>Malosma laurina</i>–<i>Rhus ovata</i>–<i>Ceanothus megacarpus</i> association; <i>Prunus fremontii</i> alliance; <i>Prunus ilicifolia</i> alliance; <i>Quercus berberidifolia</i> alliance; <i>Quercus cornelius-mulleri</i> alliance; <i>Simmondsia chinensis</i> alliance; and <i>Viguiera parishii</i> alliance.</p> |
| <b>B. Habitat affinity and breadth of habitat</b>                                                                           | Along canyons and slopes of the coast ranges and mountains foothills, mostly in chaparral (McMinn 1939; Miller & Wilken 2012, 2016). Also on the slopes of drainages within coastal sage scrub and occasionally along well drained terraces within alluvial scrub. Stands occur in coastal exposures but inland they tend to occupy areas with hot dry summers where nighttime temperatures drop below freezing in winter (Sawyer et al. 2009). Stands also occur along the drier western subsections of the Inland Mountains and Valleys, including along desert margins (see III. D. Distribution in California).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| <b>C. Elevation range</b>                         | Below 1300 m (4,265 ft) (Miller & Wilken 2012). Some mountain populations survive in sites with minimum temperatures below -20°C (Boorse et al. 1998). The thick, leathery leaves tolerate reduced water availability stemming from high levels of embolism (cavitation) during freezing and thawing (Pratt et al. 2005). This may also be related to drought tolerance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>D. Soil: texture, chemicals, depth</b>         | Well drained soils derived from both granitic and sedimentary parent materials. Occurs in shallow to deep soils. Not in alkaline soils. (A. Montalvo & E. Riordan unpublished data)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>E. Precipitation</b>                           | Occurs in Mediterranean climate zone with cool to cold moist winters and warm to hot dry summers where precipitation falls primarily from November through May during the cool season. <i>Rhus ovata</i> tends to occur where total annual precipitation is from 10 to 25 in. Annual normal precipitation ranges from 10 to 40 in (250 to 1,020 mm) in the Southern California Mountains and Valleys (M262B), and from 10 to 25 in (250 to 640 mm) in the Southern California Coast (261B).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>F. Drought tolerance</b>                       | Drought tolerant. During summer drought, sugarbush retains its large, tough, sclerophyllous leaves while maintaining high daytime water potentials relative to co-occurring species and responsive stomata that close to retain moisture (Poole & Miller 1975). Survival of post-fire resprouts was 100% during an intense drought (Pratt et al. 2014). However, Feng et al. (2017) observed 24% loss in cover of <i>Rhus ovata</i> from dieback in response to intense drought at an ecotone between chaparral and desert scrub (where less winter rain and more summer rainfall events occur compared to most of the species' range). Modeling by Feng et al. (2017) found that <i>R. ovata</i> depends on adequate winter precipitation to recharge deep soil moisture, reflected in its more coastal distribution, and it is not particularly sensitive to summer rainfall. The model suggests that <i>R. ovata</i> could be adversely affected by altered rainfall seasonality, specifically reduced winter precipitation. |
| <b>G. Flooding or high water tolerance</b>        | In well-drained substrates of alluvial terraces can withstand rare flooding events and withstands occasional summer irrigation (A. Montalvo pers. obs.).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>H. Wetland indicator status for California</b> | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>I. Shade tolerance</b>                         | Full sun to partial shade. Seedlings emerge in full sun or shade. Although tolerant of subzero temperatures, seedlings are more sensitive to freezing temperatures in winter than adults and may benefit from some cover (Boorse et al. 1998).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## V. CLIMATE CHANGE AND PROJECTED FUTURE SUITABLE HABITAT





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| <b>B. SDM summary</b>                                    | <p>Species distribution modeling suggests <i>R. ovata</i> could maintain much of its suitable habitat under projected climate change. Assuming a future of continued high greenhouse gas emissions, SDMs predicted 85–99 % of baseline suitable habitat for <i>R. ovata</i> would remain suitable under mid-century climate conditions across five different general circulation models (GCMs) (V. A. Fig. B). SDMs also predicted a moderate gain in suitable habitat (28–55 %) with expansion along the coast and into higher elevations, especially in the San Gabriel Mountains. These potential habitat gains are greater than those predicted in a recent SDM study by Principe et al. (2013); they also predicted a smaller degree of currently climatically suitable habitat in San Diego County, but similar future habitat stability under mid-century climate change.</p> <p>While SDMs suggest a low risk of climate-change driven habitat loss for <i>R. ovata</i>, increased wildfire risk caused by climate change (Westerling et al. 2011), and continued urbanization and population growth (Syphard et al. 2009) could negatively affect the species. Too-frequent fires threaten chaparral shrubs and can cause abrupt shifts to annual grasses (Zedler et al. 1983, Haidinger and Keeley 1993). In addition, the distribution of <i>R. ovata</i> is not as continuous as habitat suitability maps suggest. The high level of habitat conversion and fragmentation in southern California, especially at lower elevations, may pose considerable barriers to dispersal and gene flow that could lower the adaptive capacity and ability of the species to move across the landscape in response to changing conditions. Threats of habitat loss to urbanization are likely greatest in low elevation areas that overlap with high pressure for land development.</p> |
| <b>C. SDM caveats</b>                                    | <p>The five general circulation models (GCMs) used to predict future habitat suitability assume a ‘business-as-usual’ scenario of high greenhouse gas emissions that tracks our current trajectory (IPCC scenario RCP 8.5). They show how climate may change in southern California and highlight some of the uncertainty in these changes. The true conditions at mid-21st century, however, may not be encompassed in these five models. Predictions of current and future habitat suitability should be interpreted with caution and are best applied in concert with knowledge about the biology, ecology, and population dynamics and demographics of the species. They are best interpreted as estimates of exposure to projected climate change. Our models characterize habitat suitability with respect to climate and parent geology but do not include other factors, such as biotic interactions or disturbance regimes, that may also influence species distributions. Additionally, they do not include the adaptive capacity of a species, which will affect its sensitivity to changes in climate. See Riordan et al. (2018) for more information on SDM caveats.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>VI. GROWTH, REPRODUCTION, AND DISPERSAL</b>           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>A. Seedling emergence relevant to general ecology</b> | <p>Upwards of 90% of seedlings emerge the first year after fire with scattered seedlings in subsequent years (Keeley et al. 2006). Limited seedling recruitment occurs in open to partially shaded areas in the absence of fire (A. Montalvo pers. obs.). Seedlings are resistant to sub-zero temperatures (at least to -10°C) and are able to emerge during the cold, wetter winter months including in cold valley bottoms (e.g., Pratt et al. 2005).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>B. Growth pattern (phenology)</b>                     | <p>Plants can take 4 to 6 years to reach reproductive maturity (e.g., Lucas et al. 2017). Most flowering is March to May (McMinn 1939, CCH 2016). Plants flush leaves late in the season (early May) possibly to escape damage due to freezing temperatures or to allow recovery from embolisms formed during winter months (Pratt et al. 2005). Live fine root mass in the top 20 cm of soil fluctuates but generally increases from May to late October; dead root mass is highest mid-summer owing to dry conditions slowing decomposition (Pratt et al. 2005). Fruits mature in summer.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>C. Vegetative propagation</b>                         | <p>Plants resprout after fire, but there is no vegetative spread reported, although a number of pinnate-leaved species of <i>Rhus</i> form vegetative clones (Rowe &amp; Blazich 2008). The related <i>R. integrifolia</i> sometimes roots along buried stems (Purer 1936, Lloret &amp; Zedler 1991).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>D. Regeneration after fire or other disturbance</b>   | <p>Facultative seeder (facultative sprouter). Plants both resprout and seeds germinate from seed banks after fire; surveys of 90 postfire plots showed that seedling densities of sugarbush were about a quarter of densities observed for the related <i>Malosma laurina</i> (Keeley et al. 2006). Plants resprout readily from lignotuber buds after severe fire or cutting back and also from buds on surviving main stems (Sawyer et al. 2009). Resprouts after fire sometimes produce seeds within a year but tend to take over two years to recover mature heights (Lucas et al. 2017). Models examining the recovery of plants to different fire return intervals found relative density of <i>R. ovata</i> to have intermediate sensitivity to precipitation level (included 10, 12, and 14 inches annual totals) compared to other facultative sprouters including <i>Malosma laurina</i>, and <i>Ceanothus spinosus</i> (Lucas et al. 2017). Both <i>R. ovata</i> and <i>M. laurina</i> were predicted to persist over a variety of fire return intervals (from 1 to 30 years) owing to high survival rates of resprouts, however their canopy densities decline with shorter intervals. Although resprouts are expected to do well under the precipitation regimes studied, Jacobsen et al. (2016) found resprouts to have different xylem vessel structure than unburned plants. Resprouts were somewhat more vulnerable to dehydration and episodes of drought, but less so than most other chaparral taxa in the study.</p>                                                                                                                                                                                                                                                                                                                                               |

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| <b>E. Pollination</b>                                                   | Flowers are pollinated by a variety of bee species. In one study, the most frequent flower visitors (foraging for pollen and nectar) were bees, including <i>Apis mellifera</i> and several species of <i>Andrena</i> (Young 1972). Moldenke & Neff (1974) recorded visits by a variety of small bees, including in the genera <i>Andrena</i> , <i>Perdita</i> , <i>Nomada</i> , <i>Evylaeus</i> , and <i>Nomada</i> . They also recorded visits by <i>Bombus edwardsii</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>F. Seed dispersal</b>                                                | Fruits and seeds of <i>Rhus</i> are generally bird and mammal dispersed (Rowe & Blazich 2008). In the similar <i>R. integrifolia</i> , although most seeds dropped under or close to parent shrubs, animals dispersed fruits before and after they fell (Lloret & Zedler 1991).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>G. Breeding system, mating system</b>                                | Gynodioecious and self-incompatible. A proportion of a population can have some plants with only female flowers, some that are hermaphroditic with bisexual flowers, and some with a combination of male-sterile female flowers and bisexual flowers (Young 1972). In three populations scored by Young, 6, 18 and 20% of the plants were male-sterile and these were the plants that set the most fruits. Detailed hand-pollination experiments showed flowers are self-incompatible and that the matings are strictly outcrossed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>H. Hybridization potential</b>                                       | Hybridizes with <i>Rhus integrifolia</i> (Miller & Wilken 2012). Young (1972) found both species are visited by the same bees and he found morphological intermediate plants in populations where the plants co-occur. He also performed crosses between <i>R. integrifolia</i> and <i>R. ovata</i> to determine crossing fertility. Only 19.6% of interspecific crosses produced seeds whereas 61% and 73% of crosses within species produced seeds. This suggests there is a some incompatibility and loss of fitness upon hybridization.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>I. Inbreeding and outbreeding effects</b>                            | No studies found.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>VII. BIOLOGICAL INTERACTIONS</b>                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>A. Competitiveness</b>                                               | Seedlings are large relative to many other shrub species and are likely to be good competitors. They also emerge early in winter which can provide a competitive advantage (see VI. A. Seedling emergence).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>B. Herbivory, seed predation, disease</b>                            | <b>Seed Predation:</b> Seed predation can be high in some populations and years. Young (1972) found 50% if seeds predated by larvae of the Chalcid wasp, <i>Eurytoma rhois</i> . Seed predation by wasps in the genus <i>Eurytoma</i> is also known for <i>Rhus glabra</i> and <i>R. trilobata</i> (Chung & Waller 1986). A single larva consumes the entire seed and leaves an exit hole upon departure. Rodents and birds likely eat some seeds along with the pericarp as in <i>R. integrifolia</i> (Lloret & Zedler 1991).<br><b>Herbivory:</b> Dusky-footed woodrats ( <i>Neotoma fuscipes</i> ) strip the bark presumably when feeding away from nests and girdle entire branches (Horton & Wright 1944, A. Montalvo pers. obs.). Other parts of sugarbush make up a minor portion of food stores in wood-rat nests (Horton & Wright 1944).<br><b>Disease:</b> Die off of whole branches sometimes occurs and is likely caused by endophytic fungi similar to those found in <i>Malosma laurina</i> (Stephen Davis pers. com.). Such infections have been found to cause such damage during extended drought. A twig "blight" has been reported to kill branches in gardens and in the wild (Lenz & Dourley 1981)). |
| <b>C. Palatability, attractiveness to animals, response to grazing</b>  | Leaves are not palatable. Not even used much by goats (Green & Newell 1982). The related <i>R. trilobata</i> is listed as poor to useless as browse for domesticated animals and as fair to poor for deer (Sampson & Jespersen 1963).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>D. Mycorrhizal? Nitrogen fixing nodules?</b>                         | No studies found. No reports for species of <i>Rhus</i> . The roots of some species of <i>Rhus</i> produce antimicrobial or other medicinally active compounds (NAE 2016 database).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>VIII. ECOLOGICAL GENETICS</b>                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>A. Ploidy</b>                                                        | n = 15 (Löve 1985). Most <i>Rhus</i> , including <i>R. trilobata</i> , <i>R. glabra</i> are n = 15, or 2n = 30 (Löve 1969, 1973, Parfitt et al. 1990). No variation in ploidy is likely.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>B. Plasticity</b>                                                    | The effects of seed germination treatments can vary among seeds collected from different maternal parents of <i>Rhus</i> , but it is not known if differences are the result of genetic differences, maternal effects, or other local environmental effects (Farmer et al. 1982).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>C. Geographic variation (morphological and physiological traits)</b> | Populations occur over a variety of elevations and winter temperature regimes. Plants were found to acclimate to cold temperatures, however response to freezing temperatures differed for seedlings and adults collected from a warm, low elevation site but not for those from a colder, higher elevation site (Boorse et al. 1998). It is not known if differences in resistance to cold are genetically based.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>D. Genetic variation and population structure</b>                             | No studies found for sugarbush, but there are data for three clone-producing species of <i>Rhus</i> , all of which are dioecious shrubs. <i>R. glabra</i> is very widely distributed across North America, <i>R. copallina</i> is widely distributed in the eastern half of the US and Canada, and <i>R. michauxii</i> is rare and distributed from North Carolina to Florida. Based on allozyme surveys of many samples from at least six populations each across North Carolina and Georgia, mean genetic diversity within populations was lower for the rare <i>R. michauxii</i> ( $H_e = 0.05$ ) than for the other two species ( $H_e = 0.15$ for both) (Sherman-Broyles et al. 1992). The average percentage of polymorphic loci was 48 and 56% for the two, widespread species. The proportion of genetic diversity among populations was high for <i>R. michauxii</i> , indicating large differences among populations in allele frequencies. Structuring was lower for the widespread <i>R. copallina</i> ( $G_{ST} = 0.0264$ ) and <i>R. glabra</i> ( $G_{ST} = 0.100$ ) when considering only N. Carolina and Georgia populations. High levels of genetic diversity and low population structure are also likely in sugarbush which is common within its region of distribution, has outcrossed, insect-pollinated flowers, and bird-dispersed fruits. |
| <b>E. Phenotypic or genotypic variation in interactions with other organisms</b> | No studies found.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>F. Local adaptation</b>                                                       | There is some data consistent with populations being locally adapted to different temperature regimes, but common garden studies are needed to determine if differences are purely environmentally-determined (see VIII. C. Geographic variation).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>G. Translocation risks</b>                                                    | There are no common garden or provenance tests for this species. Outbreeding risks from translocation among suitable habitats within ecological regions and among adjacent subregions are likely low for this highly outcrossing species with animal dispersed fruits if confined to similar winter temperature regimes (see VIII. C. Geographic variation).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>IX. SEEDS</b>                                                                 | <div>  <p>Mature fruits; viscid and taste acidic.<br/>Photos: A. Montalvo</p> </div> <div> <p><i>Rhus ovata</i> cleaned seeds (nutlets) A. Montalvo.</p>  <p>5 mm</p> <p>8 mm</p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>A. General</b>                                                                | The nutlets (referred to as seeds) are about 3–5 mm long and slightly flattened. Seeds lack endosperm (Rowe & Blazich 2008).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>B. Seed longevity</b>                                                         | Long-lived. Seeds accumulate in the duff and soil and form a soil seed bank, however seed predators may remove many seeds soon after dispersal seeds before they become incorporated into the soil (see VII. B. Herbivory, seed predation). The soil seed bank of other species of <i>Rhus</i> can have highly contrasting seed densities and annual depletion/input rates with seed bank longevity estimated at +/- 5 years or > 5 to 30 years (Li et al. 1999a).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>C. Seed dormancy</b>                                                          | Dormant. Physical dormancy from the impermeable endocarp and seed coat (Stone & Juhren 1951).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>D. Seed maturation</b>                                                        | Fruits mature over the summer. The drupes can be collected in late summer into the fall when they become dry and nutlets are light brown.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>E. Seed collecting and harvesting</b>                                         | Collect fruits primarily from July through August when drupes become dry and the nutlets are hard and light brown. Fruits may stay on the plants into the fall allowing late collection. Hand pick clusters of fruits or rub/beat them into open containers or canvas sacks. Seed filling is variable among years and can be very low in drought years. Before investing in the time to collect, check on the proportion of filled seeds. Also check for seed predators because in some years many seeds will be consumed by Chalcid larvae (see VII. B. Herbivory and seed predation).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| <b>F. Seed processing</b>                                                                                                                                                                    | Extract seeds from dry clusters and twigs by rubbing through a screen, then screening to remove debris. It is not necessary to remove fruit walls completely for treating seeds and planting, but it is easier to separate empty seeds from filled seeds by floatation if cleaned. The partially cleaned seeds can be run through a macerator with water to float off empty seeds and pieces of the fruit walls (Rowe & Blazich 2008) or small batches of seeds can be thrashed in water in a blender with blades covered with duct tape or rubber tubing to beat off the outer drupe walls. Fruits can be soaked first to soften fruit walls as for <i>R. trilobata</i> (Wall & McDonald 2009). Screen and float off empty seeds and remaining debris (A. Montalvo pers. obs.). Allow seeds to dry before storing. Remaining debris can be blown off at relatively high blower speeds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>G. Seed storage</b>                                                                                                                                                                       | Seeds of <i>Rhus</i> are orthodox and can be placed dry storage in sealed containers at 0 to 5°C, but some species can survive at least 10 years stored at room temperature (Rowe & Blazich 2008).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>H. Seed germination</b><br> <p>Juvenile leaves of seedlings are toothed. Photo © 2009 Robert Steers.</p> | <p>The heat of wildfire scarifies (ruptures) the seeds of sugarbush in the wild (Keeley 1991). In all species of <i>Rhus</i>, the stony covering of the nutlet and seed coat must be scarified to allow seeds to imbibe water, and treatments with heat or sulfuric acid followed by cold stratification are often successful (Rowe &amp; Blazich 2008). Fewer than 5% of fresh seeds germinate without pretreatment. Heat treatment is often used because sulfuric acid must be handled with great caution under a chemical hood, and seed lots can vary in the length of time needed before seeds are damaged. Li et al. (1999b) found species of <i>Rhus</i> responded to hot water and sulfuric acid treatment differently depending on the anatomy of the seed.</p> <p>Wright (1931) reported a range of 22% to 32% germination of <i>R. ovata</i> seeds after oven heating for 5 min at 180–200, 200–220, 220–240, and 240–260°F (lowest of these 82–93°C, highest 115–126°C), whereas lower and higher temperatures had only 2 to 9% germination. Stone &amp; Juhren (1951) found 34% of seeds germinated after oven heating for 5 min at 100°C (the highest rate out of a range of heat treatments and exposure times). Relative to heat treatments, they found nearly twice the germination after soaking seeds in concentrated sulfuric acid for soaks of 3, 4, and 5 min.</p> <p>Hot water treatment also scarifies seeds and longer soaking times may decrease time to germination. At the RCRC, an average of 26.4% of seeds (cleaned of pulp) produced seedlings after pouring boiling water over them in cups and soaking about 1 min, compared to an average of 3.4% germination in unheated controls (N = 2 replicates with 405 to 418 seeds per replicate, A. Montalvo unpublished data). Immediately after treatment on Nov. 4th, seeds were planted 1/2 inch deep in flats outdoors in Riverside and kept moist. The first seeds germinated 8 wk later with final scoring February 15 after ample exposure to cold nights (few emerged later and seeds were not tested for filling). Dehart (1994) recommends pouring near boiling water over seeds and letting them cool in the water overnight, and Everett (2012) found seeds began germinating 9 to 15 days after a 24-hour hot water soak.</p> |
| <b>I. Seeds/lb</b>                                                                                                                                                                           | 17,000 fruits/lb and 18,700 to 26,000 cleaned seeds/lb based on two samples (Rowe & Blazich 2008). Average live seeds per bulk lb = 16,170 (S&S Seeds 2016). Average wt of 100 cleaned seeds = 0.0044 lb provides estimate of 22,700 seeds/lb (N = 2 samples from single seed lot from Santa Ana Mtns., A. Montalvo pers. obs.).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>J. Planting</b>                                                                                                                                                                           | Plant scarified seeds (see IX. H. Seed Germination) about 1/4 to 1/2 inch deep in well-drained seedling mix. In southern California, planting scarified seeds in flats outdoors in fall allows for natural cold treatment and diurnal temperature fluctuations conducive to germination (Rowe & Blazich 2008). Seeds will germinate under greenhouse conditions after being treated (NPNPP 2016).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>K. Seed increase activities or potential</b>                                                                                                                                              | None reported. If grown in orchards, many plants would need to be grown to ensure sufficient numbers of female and hermaphroditic plants (see VI. Breeding system).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>X. USES</b>                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>A. Revegetation and erosion control</b>                                                                                                                                                   | Container plants commonly used for rehabilitation in southwestern California (Newton & Classen 2003). The deep root system, evergreen foliage, and extensive cover are especially useful for stabilizing embankments (A. Montalvo pers. obs.). <i>Rhus ovata</i> (or the similar <i>R. integrifolia</i> ) is included on some municipal lists of species acceptable for planting in fuel modification zones (e.g., Santa Monica Mountains Fire Safe Alliance 2010, County of Riverside 2013).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>B. Habitat restoration</b>                                                                                                                                                                | <p>Plants have been used successfully in restoration of chaparral and banks above riparian areas (A. Montalvo pers. obs.). If container plants are installed in the fall and rainfall is at least normal, supplemental irrigation may only be needed until late spring. Under drought conditions, irrigation should be continued about every one to two weeks through the first dry season. For self-sustaining populations, it is important to plant enough individuals to ensure fruit production.</p> <p>In a restoration experiment using 2-gallon containers, plant survival was significantly higher in plots where weeds were controlled with herbicide (Engel 2014). In an outplanting trial comparing different container types, plants of the similar <i>R. integrifolia</i> grown in deep one-gallon containers had higher survival rates than for those grown in liners or 15-gallon pots (Burkhart 2006).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>C. Horticulture or agriculture</b>                             | <p><b>Horticultural Use:</b> The evergreen, glossy, dark green leaves, reddish twigs and inflorescence bracts, adaptability, and drought tolerance make this a highly desirable shrub for landscaping (McMinn 1939, Lens &amp; Dourley 1981, Bornstein et al. 2005, Perry 2010). Often used in vegetation screens or as a background plant. Performs well on slopes and can be hedged. Sugabush is also a great plant for agricultural hedgrows. Container plants are most easily started from seeds and young seedlings need to be transplanted directly into deep pots to make room for a long tap root (Lenz 1956), however cultivars are started from cuttings (Lenz &amp; Dourley 1981). Everett (2012) describes a cultivar 'Rhus Claremont' that may be a hybrid with <i>R. integrifolia</i>. Considered "fire resistant" for landscaping (Schmidt 1980, see also X. A., above).</p> <p><b>Pathogens:</b> Grow in well drained potting mix and allowed to dry between watering to avoid root rot. Shoots were tested for ability of glossy winged sharpshooters to infect plants with the xylem-blocking bacterium <i>Xylella fastidiosa</i> and results were negative (Costa et al. 2004). Plants are sometimes affected by a twig blight and may be susceptible to oak root fungus (Lenz &amp; Dourley 1981).</p> |
| <b>D. Wildlife value</b>                                          | Plants produce high quality cover for birds and small mammals. Various avian species forage in the leaf litter and the stick nests of the dusky-footed woodrat are often found under plants (A. Montalvo pers. obs.).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>E. Plant material releases by NRCS and cooperators</b>         | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>F. Ethnobotanical</b>                                          | The fruits used similarly to <i>Rhus integrifolia</i> by the Chumash and Cahuilla (Timbrook 2007). The Cahuilla ate the fruits fresh, dried, or ground into a flour for mush (Bean & Saubel 1972). Both the Cahuilla and Chumash made a tea from the leaves for coughs and colds (Bean & Saubel 1972, Garcia & Adams 2009). The fruits were also mixed with water for a drink but the flavor is not as good as with <i>R. integrifolia</i> (Garcia & Adams 2009). Barkley (1937) found reports of flower clusters being boiled and eaten by the Cahuilla. <i>Rhus</i> plants contain flavones, cardanols, bichalcones and some compounds with antiviral and antibacterial properties (Garcia & Adams 2009).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>XI. ACKNOWLEDGMENTS</b>                                        | Partial funding for production of this plant profile was provided by the U.S. Department of Agriculture, Forest Service, Pacific Southwest Region Native Plant Materials Program and the Riverside-Corona Resource Conservation District. We thank Stephen Davis and Aaron Echols for comments on the manuscript.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>XII. CITATION</b>                                              | Montalvo, A. M., E. C. Riordan, and J. L. Beyers. 2017. Plant Profile for <i>Rhus ovata</i> . Native Plant Recommendations for Southern California Ecoregions. Riverside-Corona Resource Conservation District and U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Riverside, CA. Online: <a href="http://rcrcd.org/#Plant_Materials">http://rcrcd.org/#Plant_Materials</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>XIII. LINKS TO REVIEWED DATABASES &amp; PLANT PROFILES</b>     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Fire Effects and Information System (FEIS)</b>                 | Not available. Congeners profiled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Calflora</b>                                                   | <a href="http://www.calflora.org/cgi-bin/species_query.cgi?where-calrecnum=7091">http://www.calflora.org/cgi-bin/species_query.cgi?where-calrecnum=7091</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Jepson Interchange</b>                                         | <a href="http://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?41191">http://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?41191</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Jepson eFlora (JepsonOnline, 2nd ed.)</b>                      | <a href="http://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=41191">http://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=41191</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>USDA PLANTS</b>                                                | <a href="http://plants.usda.gov/core/profile?symbol=RHOV">http://plants.usda.gov/core/profile?symbol=RHOV</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Native Plant Network Propagation Protocol Database (NPNPP)</b> | <a href="http://nnp.rngr.net/propagation">http://nnp.rngr.net/propagation</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>GRIN (provides links to many resources)</b>                    | <a href="https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=408332">https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=408332</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Native American Ethnobotany (NAE)</b>                          | <a href="http://naeb.brit.org/uses/search/?string=Rhus+ovata">http://naeb.brit.org/uses/search/?string=Rhus+ovata</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Woody Plant Seed Manual</b>                                    | <a href="http://www.nsl.fs.fed.us/nsl_wpsm.html">http://www.nsl.fs.fed.us/nsl_wpsm.html</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Rancho Santa Ana Botanic Garden Seed Program, seed photos</b>  | <a href="http://www.hazmac.biz/061009b/061009bRhusOvata.html">http://www.hazmac.biz/061009b/061009bRhusOvata.html</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>XIV. IMAGE USE</b>                                             | Photo of seedling by Robert Steers in IX. H: The thumbnail photo may be freely used for personal or academic purposes without prior permission under the Fair Use provisions of US copyright law as long as the photo is clearly credited with © 2009 Robert Steers. Photos by Arlee Montalvo may be freely used for non-commercial, educational purposes as long as photo is clearly credited with © 2017 Arlee Montalvo. SDM and distribution maps may be freely used as long as this publication is clearly credited.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |



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