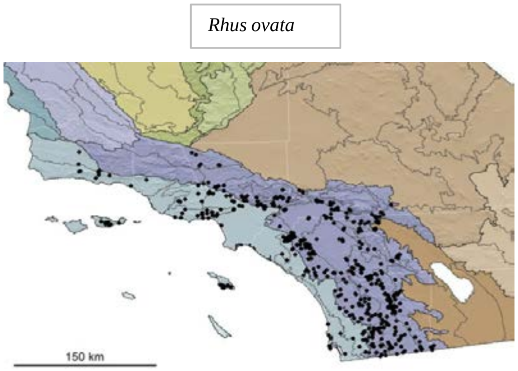
I. SPECIES	***Rhus ovata* S. Watson**
NRCS CODE: **(RHOV)** 	Family: **Anacardiaceae** Order: **Sapindales** Subclass: **Rosidae** Class: **Magnoliopsida**   photos: A. Montalvo
A. Subspecific taxa	None.
B. Synonyms	*R. ovata* var. *traskiae* F. A. Barkley (USDA PLANTS 2016)
C. Common name	sugarbush; sugar bush, occasionally sugar sumac (McMinn 1939)
D. Taxonomic relationships	There are over 20 species of *Rhus* in North America, Europe, and Asia. The most recent phylogentic analysis using a combination of molecular, morphological, and anatomical traits places *R. ovata* in section *Styphonia* with *R. integrifolia* (Nutt.) Rothr. as its closest relative (Andrés-Hernández et al. 2014).
E. Related taxa in region	Two species of *Rhus* co-occur with sugarbush in California. *Rhus integrifolia* 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. *Rhus aromatica* Aiton (=*R. trilobata* Torrey & Gray) is a low growing shrub with flexible arching branches and compound leaves.
F. Taxonomic issues	In areas where *R. ovata* and *R. integrifolia* 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). *R. ovata* may have some teeth on leaves of mature plants.
G. Other	The specific epithet, ovata, refers to the egg-shaped leaves. Plants produce a resin.

II. ECOLOGICAL & EVOLUTIONARY CONSIDERATIONS FOR RESTORATION

A. Attribute summary list (based on referenced responses in full table)	Taxonomic stability - high Longevity - long lived (to > 100 yr) Parity - polycarpic First reproduction- ~ 4 to 6 yr Stress tolerance - moderate to high Environmental tolerance - moderately broad Reproduction - facultative seeder after fire Fragmentation history - recent Habitat fragmentation - high at low elevations Distribution - narrow but common Seeds - dormant, long-lived Seed dispersal distance - short to far Pollen dispersal - intermediate to far Breeding system - outcrossed Population structure - likely low (as in congener) Adaptive trait variation - possible physiological Chromosome number - diploid, variation unlikely Genetic marker polymorphism - likely high (as in congener) Average total heterozygosity - likely high (as in congener) Hybridization potential - moderate SDM projected midcentury suitable habitat - predict 85–95 % stable SDM projected midcentury habitat gain - predict moderate gain with gain >> loss
B. Implications for seed transfer (summary)	*Rhus ovata* 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 in 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.

III. GENERAL

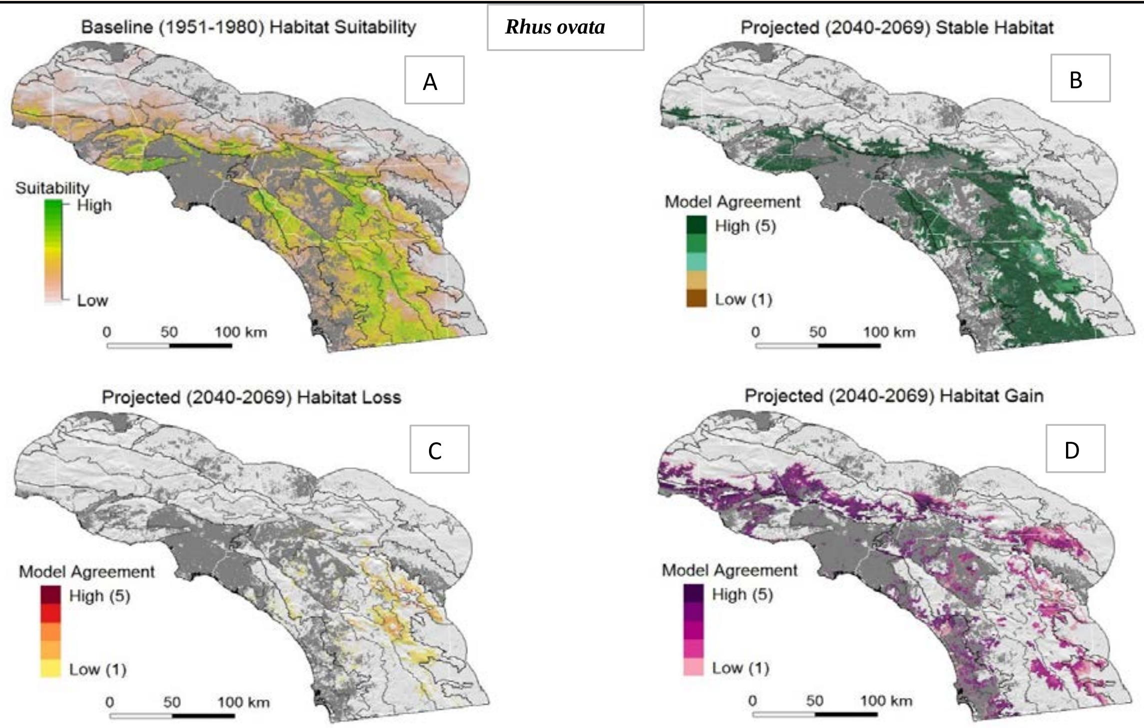
C. Geographic range	Common in southern California from Santa Barbara and Ventura counties and Catalina Is. southward into Baja California; also in Arizona (McMinn 1939, Miller & Wilken 2012).
D. Distribution in California; ecological section and subsection (sensu Goudey & Smith 1994; Cleland et al. 2007) Section Code 261A 261B 262A 263A M261A M261B M261C M261D M261E M261F M261G M262A M262B 322A 322B 322C 341D 341F 342B Salton Sea	Map includes validated herbarium records (CCH 2016) as well as occurrence data from CalFlora (2016) and field surveys (Riordan et al. 2018). Planted occurrences were excluded. Legend has Ecological Sections; black lines are subsections. Ecological Section/subsection : Southern California Mountains and Valleys M262B: a-p (western, low elevation of h) Southern California Coast 261B: a-c,e-j Mojave Desert 322A: g (bordering M262B) Colorado Desert 322C: a (bordering M262B) 
E. Life history, life form	Polycarpic, evergreen woody shrub or small tree. Long-lived, to over 100 yr (Sawyer et al. 2009).
F. Distinguishing traits	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.
G. Root system, rhizomes, stolons, etc.	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 *R. integrifolia* was found to have a tap root with long lateral branches extending 10 feet beyond the canopy (Purer 1936).
H. Rooting depth	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 *R. ovata* must be deep-rooted based on relatively high water potentials maintained through the dry season. The related *Malosma laurina* and *Rhus glabra* can produce roots over 6 m deep (DeSouza et al. 1986, Canadell 1996). Along a road cut, *Malosma* roots were 13.2 m deep.

IV. HABITAT

A. Vegetation alliances, associations (sensu Sawyer et al. 2009)	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 *Rhus ovata* alliance (membership rule > 30% relative cover) includes the following associations: *Rhus ovata–Salvia leucophylla –Artemisia californica* scrub and *Rhus ovata–Zisiphus parryi* scrub. Toyon is also a significant associate or co-dominate in the following shubland and woodland plant communities (Sawyer et al. 2009): Woodlands: *Prosopic glandulosa/Rhus ovata* (upper desert spring) association; *Acacia greggii* alliance Shrublands: *Adenostoma fasciculatum–Salvia apiana* alliance; *Adenostoma fasciculatum–Salvia mellifera–Rhus ovata* association; *Arctostaphylos glandulosa* alliance; *Artemisa californica–Eriogonum fasciculatum* alliance; *Ceanothus crassifolius* alliance especially the *Ceanothus crassifolius–Adenostoma fasciculatum–Rhus ovata* assiciation; *Ceanothus cuneatus* alliance; *Ceanothus perplexans* alliance; *Ceanothus oliganthus* alliance; *Ceanothus oliganthus–Heteomeles arbutifolia –Rhus ovata* association; *Ceanothus spinosus* alliance; *Eriodictyon crassifolium* alliance; *Eriogonum fasciculatum* alliance; *Heteromeles arubutifolia* alliance; *Keckiella antirrhinoides* alliance; *Lepidospartum squamatum* alliance; *Malacothmnus fasciculatus* alliance; *Malosma laurina* alliance; *Malosma laurina–Rhus ovata–Ceanothus megacarpus* association; *Prunus fremonttii* alliance; *Prunus ilicifolia* alliance; *Quercus berberidifolia* alliance; *Quercus cornelius-mulleri* alliance; *Simmondsia chinensis* alliance; and *Viguiera parishii* alliance.
B. Habitat affinity and breadth of habitat	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).

C. Elevation range	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.
D. Soil: texture, chemicals, depth	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)
E. Precipitation	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. *Rhus ovata* 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).
F. Drought tolerance	Drought tolerant. During summer drought, sugarbush retains its large, tough, scleophyllous 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 *Rhus ovata* 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 *R. ovata* 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 *R. ovata* could be adversely affected by altered rainfall seasonality, specifically reduced winter precipitation.
G. Flooding or high water tolerance	In well-drained substrates of alluvial terraces can withstand rare flooding events and withstands occasional summer irrigation (A. Montalvo pers. obs.).
H. Wetland indicator status for California	None.
I. Shade tolerance	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



A. Species Distribution Models (SDM forecasts, Riordan et al. 2018) Map descriptions	Modeled habitat suitability under (A) baseline (1951–1980) and (B–D) projected midcentury (2040–2069) climate conditions. Projected future habitat suitability maps show agreement across five different climate model scenarios: (B) stable = suitable under both baseline and future conditions; (C) loss = suitable under baseline but unsuitable under future conditions; (D) gain = unsuitable under baseline and becoming suitable under future conditions. In all maps, land area that has already been converted to urban and agriculture land uses is masked in dark gray (FRAP 2015 Assessment; https://map.dfg.ca.gov/metadata/ds1327.html).

B. SDM summary	Species distribution modeling suggests *R. ovata* 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 *R. ovata* 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. While SDMs suggest a low risk of climate-change driven habitat loss for *R. ovata,* 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 *R. ovata* 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.
C. SDM caveats	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.

VI. GROWTH, REPRODUCTION, AND DISPERSAL

A. Seedling emergence relevant to general ecology	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).
B. Growth pattern (phenology)	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.
C. Vegetative propagation	Plants resprout after fire, but there is no vegetative spread reported, although a number of pinnate-leaved species of *Rhus* form vegetative clones (Rowe & Blazich 2008). The related *R. integrifolia* sometimes roots along buried stems (Purer 1936, Lloret & Zedler 1991).
D. Regeneration after fire or other disturbance	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 *Malosma laurina* (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 *R. ovata* to have intermediate sensitivity to precipitation level (included 10, 12, and 14 inches annual totals) compared to other facultative sprouters including *Malosma laurina* , and *Ceanothus spinosus* (Lucas et al. 2017). Both *R. ovata* and *M. laurina* 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.

E. Pollination	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 *Apis mellifera* and several species of *Andrena* (Young 1972). Moldenke & Neff (1974) recorded visits by a variety of small bees, including in the genera *Andrena, Perdita, Nomada, Evylaeus,* and *Nomada.* They also recorded visits by *Bombus edwardsii* .
F. Seed dispersal	Fruits and seeds of *Rhus* are generally bird and mammal dispersed (Rowe & Blazich 2008). In the similar *R. integrifolia,* although most seeds dropped under or close to parent shrubs, animals dispersed fruits before and after they fell (Lloret & Zedler 1991).
G. Breeding system, mating system	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.
H. Hybridization potential	Hybridizes with *Rhus integrifolia* (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 *R. integrifolia* and *R. ovata* 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.
I. Inbreeding and outbreeding effects	No studies found.

VII. BIOLOGICAL INTERACTIONS

A. Competitiveness	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. Herbivory, seed predation, disease	**Seed Predation:** Seed predation can be high in some populations and years. Young (1972) found 50% if seeds predated by larvae of the Chalcid wasp, Eurytoma rhois. Seed predation by wasps in the genus Eurytoma is also known for *Rhus glabra* and *R. trilobata* (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 *R. integrifolia* (Lloret & Zedler 1991). **Herbivory:** Dusky-footed woodrats (Neotoma fuscipes) 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). **Disease:** Die off of whole branches sometimes occurs and is likely caused by endophytic fungi similar to those found in *Malosma laurina* (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)).
C. Palatability, attractiveness to animals, response to grazing	Leaves are not palatable. Not even used much by goats (Green & Newell 1982). The related *R. trilobata* is listed as poor to useless as browse for domesticated animals and as fair to poor for deer (Sampson & Jespersen 1963).
D. Mycorrhizal? Nitrogen fixing nodules?	No studies found. No reports for species of *Rhus.* The roots of some species of *Rhus* produce antimicrobial or other medicinally active compounds (NAE 2016 database).

VIII. ECOLOGICAL GENETICS

A. Ploidy	n = 15 (Löve 1985). Most *Rhus,* including *R. trilobata, R. glabra* are n = 15, or 2n = 30 (Löve 1969, 1973, Parfitt et al. 1990). No variation in ploidy is likely.
B. Plasticity	The effects of seed germination treatments can vary among seeds collected from different maternal parents of *Rhus,* but it is not known if differences are the result of genetic differences, maternal effects, or other local environmental effects (Farmer et al. 1982).
C. Geographic variation (morphological and physiological traits)	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.

D. Genetic variation and population structure	No studies found for sugarbush, but there are data for three clone-producing species of *Rhus,* all of which are dioecious shrubs. *R. glabra* is very widely distributed across North America, *R. copallina* is widely distributed in the eastern half of the US and Canada, and *R. michauxii* 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 *R. michauxii* ($H_e = 0.05$) 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 *R. michauxii,* indicating large differences among populations in allele frequencies. Structuring was lower for the widespread *R. copallina* ($G_{ST} = 0.0.264$) and *R. glabra* ($G_{ST} = 0.100$) 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.
E. Phenotypic or genotypic variation in interactions with other organisms	No studies found.
F. Local adaptation	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).
G. Translocation risks	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).
IX. SEEDS	 Mature fruits; viscid and taste acidic. Photos: A. Montalvo *Rhus ovata* cleaned seeds (nutlets) A. Montalvo. 
A. General	The nutlets (referred to as seeds) are about 3–5 mm long and slightly flattened. Seeds lack endosperm (Rowe & Blazich 2008).
B. Seed longevity	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 *Rhus* 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).
C. Seed dormancy	Dormant. Physical dormancy from the impermeable endocarp and seed coat (Stone & Juhren 1951).
D. Seed maturation	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.
E. Seed collecting and harvesting	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).

F. Seed processing	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 *R. trilobata* (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.
G. Seed storage	Seeds of *Rhus* 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).
H. Seed germination  Juvenile leaves of seedlings are toothed. Photo © 2009 Robert Steers.	The heat of wildfire scarifies (ruptures) the seeds of sugarbush in the wild (Keeley 1991). In all species of *Rhus,* 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 & 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 *Rhus* responded to hot water and sulfuric acid treatment differently depending on the anatomy of the seed. Wright (1931) reported a range of 22% to 32% germination of *R. ovata* 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 & 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. Hot water treatment also scarifies seeds and longer soaking times may decrease time to germination. At the RCRCD, 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.
I. Seeds/lb	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.).
J. Planting	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).
K. Seed increase activities or potential	None reported. If grown in orchards, many plants would need to be grown to ensure sufficient numbers of female and hermaphroditic pants (see VI. Breeding system).
X. USES	
A. Revegetation and erosion control	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.). *Rhus ovata* (or the similar *R. integrifolia*) 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. Habitat restoration	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. 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 *R. integrifolia* grown in deep one-gallon containers had higher survival rates than for those grown in liners or 15-gallon pots (Burkhart 2006).

C. Horticulture or agriculture	**Horticultural Use:** 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 & 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 & Dourley 1981). Everett (2012) describes a cultivar 'Rhus Claremont' that may be a hybrid with *R. integrifolia*. Considered "fire resistent" for landscaping (Schmidt 1980, see also X. A., above). **Pathogens:** 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 *Xylella fastidiosa* and results were negative (Costa et al. 2004). Plants are sometimes affected by a twig blight and may be suscesptible to oak root fungus (Lenz & Dourley 1981).
D. Wildlife value	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.).
E. Plant material releases by NRCS and cooperators	None.
F. Ethnobotanical	The fruits used similarly to *Rhus integrifolia* 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 *R. integrifolia* (Garcia & Adams 2009). Barkley (1937) found reports of flower clusters being boiled and eaten by the Cahuilla. *Rhus* plants contain flavones, cardanols, bichalcones and some compounds with antiviral and antibacterial properties (Garcia & Adams 2009).
XI. ACKNOWLEDGMENTS	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.
XII. CITATION	Montalvo, A. M., E. C. Riordan, and J. L. Beyers. 2017. Plant Profile for *Rhus ovata*. 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: https://www.rcrcd.org/plant-profiles

XIII. LINKS TO REVIEWED DATABASES & PLANT PROFILES

Fire Effects and Information System (FEIS)	Not available. Congeners profiled: https://www.feis-crs.org/feis/.
Calflora	https://www.calflora.org//cgi-bin/species_query.cgi?where-calrecnum=7091
Jepson Interchange	https://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?41191
Jepson eFlora (JepsonOnline, 2nd ed.)	https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=41191
USDA PLANTS	https://plants.usda.gov/core/profile?symbol=RHOV
Native Plant Network Propagation Protocol Database (NPNPP)	https://npn.rngr.net/propagation/protocols
GRIN (provides links to many recources)	https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=408332
Native American Ethnobotany (NAE)	http://naeb.brit.org/uses/search/?string=Rhus+ovata
Woody Plant Seed Manual	http://www.nsl.fs.fed.us/nsl_wpsm.html
Rancho Santa Ana Botanic Garden Seed Program, seed photos	http://www.hazmac.biz/061009b/061009bRhusOvata.html
XIV. IMAGE USE	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.

Bibliography for *Rhus ovata*

Andrés-Hernández, A. R., T. Terrazas, G. Salazar, and H. Ochoterena. 2014. Phylogenetic analysis based on structural and combined analyses of *Rhus* s.s. (Anacardiaceae). Botanical Journal of the Linnean Society **176**:452-468.

Barkley, F. A. 1937. A monographic study of *Rhus* and its immediate allies in North and Central America, including the West Indies. Annals of the Missouri Botanical Garden **24**:265-498.

Bean, J. L., and K. S. Saubel. 1972. Temalpakh: Cahuilla Indian Knowledge and Usage of Plants. Malki Museum Press, Morongo Indian Reservation, CA.

Boorse, G. C., F. W. Ewers, and S. D. Davis. 1998. Response of chaparral shrubs to below-freezing temperatures: Acclimation, ecotypes, seedlings vs. adults. American Journal of Botany **85**:1224-1230.

Bornstein, C., D. Fross, and B. O'Brien. 2005. California Native Plants for the Garden. Cachuma Press, Los Olivos, CA.

Burkhart, B. 2006. Selecting the right container for revegetation success with tap-rooted and deep-rooted chaparral and oak species. Ecological Restoration **24**:87-92.

Calflora. 2016. Information on California plants for education, research and conservation [web application]. The Calflora Database [a non-profit organization], Berkeley, California. Available: https://www.calflora.org/. [Accessed 6 April 2016].

Canadell, J., R. B. Jackson, J. B. Ehleringer, H. A. Mooney, O. E. Sala, and E.-D. Schulze. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia **108**:583-595.

CCH. 2016. Consortium of California Herbaria. Regents of the University of California, Berkeley, California. On line database: https://ucjeps.berkeley.edu/consortium/. [Accessed 6 April 2016].

Chung, J. C., and D. M. Waller. 1986. Patterns of insect predation on seeds of smooth sumac (*Rhus glabra* L.). The American Midland Naturalist **116**:315-322.

Cleland, D. T., J. A. Freeouf, J. E. Keys, G. J. Nowacki, C. A. Carpenter, and W. H. McNab. 2007. Ecological Subregions: Sections and Subsections for the Conterminous United States. General Technical Report WO-76D [Map on CD-ROM] (A.M. Sloan, cartographer). U.S. Department of Agriculture, Forest Service, Washington, DC.

County of Riverside. 2013. County of Riverside California friendly plant list._ https://rctlma.org/Portals/7/documents/landscaping_guidelines/comprehensive_plant_list.pdf [Accessed 13 April 2017].

Costa, H. S., E. Raetz, T. R. Pinckard, C. Gispert, R. Hernandez-Martinez, C. K. Dumenyo, and D. A. Cooksey. 2004. Plant hosts of *Xylella fastidiosa* in and near southern California vineyards. Plant Disease **88**:1255-1261.

De Hart, J. 1994. Propagation secrets for California native plants. Jeanine De Hart, Encinitas, CA.

DeSouza, J., P. A. Silka, and S. D. Davis. 1986. Comparative physiology of burned and unburned *Rhus laurina* after chaparral wildfire. Oecologia **71**:63-68.

Emery, D. E. 1988. Seed Propagation of Native California Plants. Santa Barbara Botanical Garden, Santa Barbara, CA.

Engel, M. D. 2014. The Feasibility of Chaparral Restoration on Type-converted Slopes. Masters thesis. California State University, San Bernardino.

Everett, P. C. 2012. A Second Summary of the Horticulture and Propagation of California Native Plants at the Rancho Santa Ana Botanic Garden, 1950-1970. Edited by Bart C. O'Brien., Rancho Santa Ana Botanic Garden, Claremont, CA.

Farmer, R. E., G. C. Lockley, and M. Cunningham. 1982. Germination patterns of the sumacs, *Rhus glabra* and *Rhus coppalina*: Effects of scarification time, temperature and genotype. Seed Science and Technology **10**:223-231.

Feng, X., T. E. Dawson, D. D. Ackerly, L. S. Santiago, and S. E. Thompson. 2017. Reconciling seasonal hydraulic risk and plant water use through probabilistic soil–plant dynamics. Global Change Biology **23**:3758-3769.

Francisco, L., and P. H. Zedler. 1991. Recruitment pattern of *Rhus integrifolia* populations in periods between fire in chaparral. Journal of Vegetation Science **2**:217-230.

Franklin, J. 1998. Predicting the distribution of shrub species in southern California from climate and terrain-derived variables. Journal of Vegetation Science **9**:733-748.

Frazer, J. M., and S. D. Davis. 1988. Differential survival of chaparral seedlings during the first summer drought after wildfire. Oecologia **76**:215-221.

Garcia, C., and J. D. Adams, Jr. 2009. Healing with Medicinal Plants of the West: Cultural and Scientific Basis for Their Use. 2nd edition. Abedus Press, La Crescentia, CA.

Genin, D., and A. Badan-Dangon. 1991. Goat herbivory and plant phenology in a Mediterranean shrubland of northern Baja California. Journal of Arid Environments **21**:113-121.

Gigon, A. 1979. CO_2 gas exchange, water relations and convergence of Mediterranean shrub-types from California and Chile. Oecologia Plantarum **14**:129-150.

Goudey, C. B., and D. W. Smith, editors. 1994. Ecological Units of California: Subsections (map). Scale 1:1,000,000; colored. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, San Francisco, CA.

Gray, J. T. 1983. Competition for light and a dynamic boundary between chaparral and coastal sage scrub. Madroño **30**:43-49.

Green, L. R., and L. A. Newell. 1982. Using goats to control brush regrowth on fuelbreaks. General Technical Report PSW-059. U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.

Hacke, U. G., A. L. Jacobsen, and R. B. Pratt. 2009. Xylem function of arid-land shrubs from California, USA: An ecological and evolutionary analysis. Plant, Cell & Environment **32**:1324-1333.

Haidinger, T. L., and J. E. Keeley. 1993. Role of high fire frequency in destruction of mixed chaparral. Madroño **40**:141-147.

Hanes, T. L., and H. W. Jones. 1967. Postfire chaparral succession in southern California. Ecology **48**:259-264.

Hartmann, H. T., D. E. Kester, J. Davies, FT, and R. L. Geneve. 1997. Plant Propagation: Principles and Practices. 6th edition. Prentice Hall, Upper Saddle River, New Jersey.

Heit, C. E. 1967. Propagation from seed. American Nurseryman **125**:10-12, 37-41, 44-45.

Heit, C. E. 1971. Propagation from seed. Part 22: Testing and growing Western desert and mountain shrub species. American Nurseryman **133**:10-12, 76-89.

Hillyard, D. 1990. Coastal sage scrub restoration in Orange County: Two approaches. Pages 20-25 *in* P. J. Bryant and J. Remington, editors. Endangered Wildlife and Habitats in Southern California. The

Natural History Foundation of Orange County, Newport Beach, CA.

Horton, J. S., and J. T. C. Wright. 1944. The wood rat as an ecological factor in southern California watersheds. Ecology **25**:341-351.

Houpis, J. L. J. 1984. Photosynthesis, water relations, and plant distribution: An ecophysiological study. Masters thesis. San Diego State University, CA.

Jacobsen, A. L., F. W. Ewers, R. B. Pratt, W. A. Paddock, and S. D. Davis. 2005. Do xylem fibers affect vessel cavitation resistance? Plant Physiology **139**:546-556.

Jacobsen, A. L., R. B. Pratt, S. D. Davis, and F. W. Ewers. 2008. Comparative community physiology: Nonconvergence in water relations among three semi-arid shrub communities. New Phytologist **180**:100-113.

Jacobsen, A. L., R. B. Pratt, S. D. Davis, and M. F. Tobin. 2014. Geographic and seasonal variation in chaparral vulnerability to cavitation. Madroño **61**:317-327.

Jacobsen, A. L., R. B. Pratt, F. W. Ewers, and S. D. Davis. 2007. Cavitation resistance among 26 chaparral species of southern California. Ecological Monographs **77**:99-115.

Jacobsen, A. L., M. F. Tobin, H. S. Toschi, M. I. Percolla, and R. B. Pratt. 2016. Structural determinants of increased susceptibility to dehydration-induced cavitation in post-fire resprouting chaparral shrubs. Plant, Cell & Environment **39**:2473-2485.

Keeley, J. E. 1987. Role of fire in seed germination of woody taxa in California chaparral. Ecology **68**:434-443.

Keeley, J. E. 1991. Seed germination and life history syndromes in the California chaparral. The Botanical Review **57**:81-116.

Keeley, J. E. 1998. Postfire ecosystem recovery and management: The October 1993 large fire episode in California. Pages 69-90 *in* J. M. Moreno, editor. Large Forest Fires. Backhuys Publishers, Leiden, The Netherlands.

Keeley, J. E., C. J. Fotheringham, and M. Baer-Keeley. 2006. Demographic patterns of postfire regeneration in Mediterranean-climate shrublands of California. Ecological Monographs **76**:235-255.

Kummerow, J., D. Krause, and W. Jow. 1978. Seasonal changes of fine root density in the southern California chaparral. Oecologia **37**:201-212.

Lenz, L. W. 1956. Native plants for California gardens. Abbey Garden Press, Pasadena, CA.

Lenz, L. W., and J. Dourley. 1981. California native trees & shrubs. Rancho Santa Ana Botanic Garden, Claremont, CA.

Li, X., J. M. Baskin, and C. C. Baskin. 1999a. Contrasting soil seed-bank dynamics in relation to local recruitment modes in two clonal shrubs, *Rhus aromatica* Ait. and *R. glabra* L. (Anacardiaceae). The American Midland Naturalist **142**:266-280.

Li, X., J. M. Baskin, and C. C. Baskin. 1999b. Seed morphology and physical dormancy of several North American *Rhus* species (Anacardiaceae). Seed Science Research **9**:247-258.

Lloret, F., and P. H. Zedler. 1991. Recruitment pattern of *Rhus integrifolia* populations in periods between fire in chaparral. Journal of Vegetation Science **2**:217-230.

Löve, A. 1969. IOPB Chromosome Number Reports. XX. Taxon **18**:213-221.

Löve, A. 1973. IOPB Chromosome Number Reports XL. Taxon **22**:285-291.

Löve, A. 1985. Chromosome Number Reports LXXXVI. Taxon **34**:159-164.

Lucas, T. A., R. A. Doña, W. Jiang, G. C. Johns, D. J. Mann, C. Seubert, N. B. C. Webster, C. H. Willens, and S. D. Davis. 2017. An individual-based model of chaparral vegetation response to frequent wildfires. Theoretical Ecology **10**:217-233.

McMinn, H. E. 1939. An Illustrated Manual of California Shrubs. J. W. Stacey, Incorporated, San Francisco, CA.

Miller, A. J., D. A. Young, and J. Wen. 2001. Phylogeny and biogeography of *Rhus* (Anacardiaceae) based on ITS sequence data. International Journal of Plant Sciences **162**:1401-1407.

Miller, J. M., and D. H. Wilken. 2012. Anacardiaceae: Sumac or cashew family. Pages 170-171 *in* Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, editors. The Jepson Manual: Vascular Plants of California. 2nd edition. University of California Press, Berkeley, CA.

Miller, J. M., and D. H. Wilken. 2016. *Rhus ovata*. *In* Jepson Flora Project (eds.) Jepson eFlora, https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=41191. [Accessed 4 July 2017].

Mirov, N. T. 1940. Additional Data on Collecting and Propagating the Seeds of California Wild Plants. Research Note 21. U.S. Department of Agriculture, Forest Service, California Forest and Range Experiment Station, Berkeley, CA.

Moldenke, A. R. 1976. California pollination ecology and vegetation types. Phytologia **34**:305-361.

Moldenke, A. R., and J. L. Neff. 1974. Studies on pollination ecology and species diversity of natural California plant communities, III. Technical Report 74-14, International Biological Programme, Origin and Structure of Ecosystems.

Montgomery, K. R., and P. C. Cheo. 1969. Moisture and salt effects on fire retardance in plants. American Journal of Botany **56**:1028-1032.

Mooney, H. A., and E. L. Dunn. 1970. Photosynthetic systems of Mediterranean-climate shrubs and trees of California and Chile. The American Naturalist **104**:447-453.

Mooney, H. A., S. L. Gulmon, D. J. Parsons, and A. T. C. Harrison. 1974. Morphological changes within the chaparral vegetation type as related to elevational gradients. Madroño **22**:281-285.

Munz, P. A., and D. D. Keck. 1968. A California Flora with Supplement. University of California Press, Berkeley, CA.

NAE. 2016. Native American Ethnobotany Database. Online: http://naeb.brit.org/. [Accessed 9 July 2017].

Parfitt, B. D., D. J. Pinkava, D. Rickel, D. Fillipi, B. Eggers, and D. J. Keil. 1990. Documented chromosome numbers 1990: 1. Miscellaneous North American vascular plants. SIDA, Contributions to Botany **14**:305-308.

Perry, R., Jr. 2010. Landscape Plants for California Gardens: An Illustrated Reference of Plants for California Landscapes. 1st edition. Land Design Publishing, Claremont, CA.

Poole, D. K., and P. C. Miller. 1975. Water relations of selected species of chaparral and coastal sage communities. Ecology **56**:1118-1128.

Pratt, R. B., F. W. Ewers, M. C. Lawson, A. L. Jacobsen, M. M. Brediger, and S. D. Davis. 2005. Mechanisms for tolerating freeze-thaw stress of two evergreen chaparral species: *Rhus ovata* and *Malosma laurina* (Anacardiaceae). American Journal of Botany **92**:1102-1113.

Pratt, R. B., A. L. Jacobsen, A. R. Ramirez, A. M. Helms, C. A. Traugh, M. F. Tobin, M. S. Heffner, and S. D. Davis. 2014. Mortality of resprouting chaparral shrubs after a fire and during a record drought: Physiological mechanisms and demographic consequences. Global Change Biology **20**:893-907.

Pratt, R. B., E. D. MacKinnon, M. D. Venturas, C. J. Crous, and A. L. Jacobsen. 2015. Root resistance to cavitation is accurately measured using a centrifuge technique. Tree Physiology **35**:185-196.

Principe, Z., J. B. MacKenzie, B. Cohen, J. M. Randall, W. Tippets, T. Smith, and S. A. Morrison. 2013. 50-Year Climate Scenarios and Plant Species Distribution Forecasts for Setting Conservation Priorities in Southwestern California v.1. The Nature Conservancy of California, San Francisco, CA.

Purer, E. A. 1936. Studies of certain coastal sand dune plants of southern California. Ecological Monographs **6**:1-87.

Radtke, K. 1988. Wildland Plantings & Urban Forestry Native & Exotic 1911-1977. County of Los Angeles Department of Forester and Fire Warden, Los Angeles, CA.

Ramirez, A. R. 2015. Comparative Ecophysiology and Evolutionary Biology of Island and Mainland Chaparral Communities. Dissertation. University of California, Berkeley.

Rasmussen, G. A., and H. A. Wright. 1988. Germination requirements of flameleaf sumac. Journal of Range Management **41**:48-52.

Riordan, E.C, A.M. Montalvo, and J. L. Beyers. 2018. Using Species Distribution Models with Climate Change Scenarios to Aid Ecological Restoration Decisionmaking for Southern California Shrublands. Research Paper PSW-RP-270. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, CA. 130 p. Available: https://www.fs.fed.us/psw/publications/documents/psw_rp270/. [Accessed 6 September 2018]

Rowe, D.B. and F.A. Blazich. 2008. *Rhus* L. Pages 954-960 *in* F. T. Bonner and R. P. Karrfalt, editors, The Woody Plant Seed Manual. Agriculture Handbook 727. U.S. Department of Agriculture, Forest Service, Washington, DC.

S&S Seeds. 2016. S & S Seeds Inc. Plant database: http://www.ssseeds.com/database/index.html. [Accessed 16 July 2016]

Sampson, A. W., and B. S. Jespersen. 1963. California Range Brushlands and Browse Plants. University of California, California Agricultural Experiment Station Manual 33.

Santa Monica Mountains Fire Safe Alliance. 2010. A Road Map to Fire Safety: How to Create Defensible Space in the Santa Monica Mountains. Available online at:_ https://www.cfpnet.com/FORMS/RoadMaptoFireSafetyRev9_11.pdf [Accessed 18 April 2017].

Sawyer, J. O., T. Keeler-Wolf, and J. M. Evens. 2009. A Manual of California Vegetation. 2nd edition. California Native Plant Society Press, Sacramento, CA.

Schmidt, M. G. 1980. Growing California Native Plants. University of California Press, Los Angeles.

Sherman-Broyles, S. L., J. P. Gibson, J. L. Hamrick, M. A. Bucher, and M. J. Gibson. 1992. Comparisons of allozyme diversity among rare and widespread *Rhus* species. Systematic Botany **17**:551-559.

Stone, E. C., and G. Juhren. 1951. The effect of fire on the germination of the seed of *Rhus ovata* Wats. American Journal of Botany **38**:368-372.

Syphard, A. D., V. C. Radeloff, T. J. Hawbaker, and S. I. Stewart. 2009. Conservation threats due to human-caused increases in fire frequency in Mediterranean-climate ecosystems. Conservation Biology **23**:758-769.

Timbrook, J. 2007. Chumash Ethnobotany: Plant Knowledge among the Chumash People of Southern California. Heyday Books, Berkeley, CA.

USDA PLANTS. 2016. The PLANTS Database (https://plants.sc.egov.usda.gov/java/). National Plant Data Team, Greensboro, NC 27401-4901 USA. [Accessed 10 August 2016].

Vaughan, T. A. 1982. Stephens' woodrat, a dietary specialist. Journal of Mammalogy **63**:53-62.

Vestal, E. H. 1938. Biotic relations of the wood rat (*Neotoma fuscipes*) in the Berkeley Hills. Journal of Mammalogy **19**:1-36.

Vogl, R. J., and P. K. Schorr. 1972. Fire and manzanita chaparral in the San Jacinto Mountains, California. Ecology **53**:1179-1188.

Wall, M., and J. Macdonald. 2009. Processing Seeds of California Native Plants for Conservation, Storage, and Restoration. Rancho Santa Ana Botanic Garden Seed Program, Claremont, CA.

Walters, D. R., M. McLeod, A. G. Meyer, D. Rible, R. O. Baker, and L. Farwell. 1977. Native Plants: A Viable Option. California Native Plant Society, Sacramento, CA.

Wells, P. V. 1969. The relation between mode of reproduction and extent of speciation in woody genera of California chaparral. Evolution **23**:264-267.

Went, F. W., G. Juhren, and M. C. Juhren. 1952. Fire and biotic factors affecting germination. Ecology **33**:351-364.

Westerling, A. L., B. P. Bryant, H. K. Preisler, T. P. Holmes, H. G. Hidalgo, T. Das, and S. R. Shrestha. 2011. Climate change and growth scenarios for California wildfire. Climatic Change **109**:445-463

Wright, E. 1931. The effect of high temperatures on seed germination. Journal of Forestry **29**:679-687.

Yi, T., A. J. Miller, and J. Wen. 2004. Phylogenetic and biogeographic diversification of *Rhus* (Anacardiaceae) in the Northern Hemisphere. Molecular Phylogenetics and Evolution **33**:861-879.

Young, D. A. 1972. The reproductive biology of *Rhus integrifolia* and *Rhus ovata* (Anacardiaceae). Evolution **26**:406-414.

Zedler, P. H., C. R. Gautier, and G. S. McMaster. 1983. Vegetation change in response to extreme events: The effects of a short interval between fires in California chaparral and coastal scrub. Ecology **64**:809-818.