I. SPECIES	*Malosma laurina* (Nutt.) Nutt. ex Abrams
NRCS CODE: MALA6	Family: **Anacardiaceae** Subfamily: **Anacardiodeae** Order: **Sapindales** Subclass: **Rosidae** Class: **Magnoliopsida**

Immature fruits are green to red in mid-summer.

Plants tend to flower in May to June.

A. Subspecific taxa	none
B. Synonyms	*Rhus laurina* Nutt. (USDA PLANTS 2017)
C. Common name	laurel sumac (McMinn 1939, Calflora 2016)
D. Taxonomic relationships	There is only one species of *Malosma.* Phylogenetic analyses based on molecular data and a combination of molecular and structural data place *Malosma* as distinct but related to both *Toxicodendron* and *Rhus* (Miller et al. 2001, Yi et al. 2004, Andrés-Hernández et al. 2014).
E. Related taxa in region	*Rhus ovata* and *Rhus integrifolia* may be the closest relatives and laurel sumac co-occurs with both species. Very early, *Malosma* was separated out of the genus *Rhus* in part because it has smaller fruits and lacks the following traits possessed by all species of *Rhus*: red-glandular hairs on the fruits and axis of the inflorescence, hairs on sepal margins, and glands on the leaf blades (Barkley 1937, Andrés-Hernández et al. 2014).
F. Taxonomic issues	none
G. Other	The name *Malosma* refers to the strong odor of the plant (Miller & Wilken 2017). The odor of the crushed leaves has been described as apple-like, but some think the smell is more like bitter almonds (Allen & Roberts 2013). The leaves are similar to those of the laurel tree and many others in family Lauraceae, hence the specific epithet "laurina." Montgomery & Cheo (1971) found time to ignition for dried leaf blades of laurel sumac to be intermediate and similar to scrub oak, *Prunus ilicifolia,* and *Rhamnus crocea;* faster than *Heteromeles arbutifolia, Arctostaphylos densiflora,* and *Rhus ovata;* and slower than *Salvia mellifera.* Time to ignition was significantly related to thickness of leaf blades. The thicker the leaf, the slower to ignite.

II. ECOLOGICAL & EVOLUTIONARY CONSIDERATIONS FOR RESTORATION

A. Attribute summary list (easy guide to help navigate decision trees)

Taxonomic stability - high
Longevity - long-lived
Parity - polycarpic
Flowering age - 5+ yr
Stress tolerance - moderate to high
Environmental tolerance - broad in adults
Reproduction after fire - facultative seeder
Fragmentation history - recent
Habitat fragmentation - high
Distribution - narrow but common

Seeds - dormant, long-lived
Seed dispersal distance - far
Pollen dispersal - intermediate to far
Breeding system - outcrossed
Population structure - likely low
Adaptive trait variation - unknown
Chromosome number - no data
Genetic marker polymorphism - no data
Average total heterozygosity - no data
Hybridization potential - low- none known

SDM projected midcentury suitable habitat - 95–100 % stable
SDM projected midcentury habitat gain - gain > loss for all five models (assuming unlimited dispersal)

B. Implications for seed transfer (summary)

Laurel sumac is an obligate outcrossing plant with potentially high levels of gene dispersal by both pollen and seeds. There may be differences among populations in cold tolerance. Risk of maladaptation can be lowered by using seeds from similar climate zones within ecological sections and subsections or from adjacent subsections. In a warming climate, laurel sumac may benefit from downhill migration into valleys where cold air drainage formerly caused freezing. The species is predicted to have low exposure to future climate change projected to mid-century. It is also predicted to withstand shortened fire return intervals better than most co-occurring species of shrubs. This taxon appears to be much more threatened by loss of habitat to development than to climate change. Laurel sumac 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

A. Geographic range

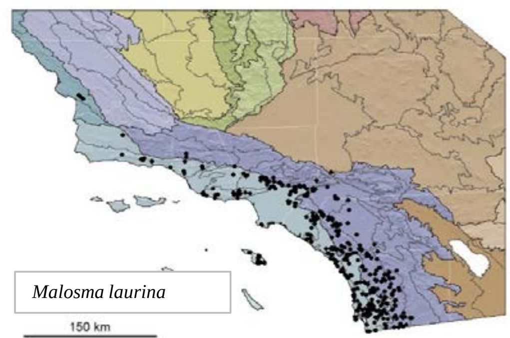
Generally restricted to below 3000 ft (915 m) in the foothills and valleys of western southern California from San Luis Obispo county southward to southern Baja California; also on San Clemente and Santa Catalina Islands (Barkley 1937, McMinn 1939, Munz & Keck 1968, Howard 1992, Miller & Wilken 2017).

B. Distribution in California; ecological section and subsection
(sensu Goudey & Smith 1994; Cleland et al. 2007)

Map includes validated herbarium records (CCH 2016) as well as occurrence data from CalFlora (2016) and field surveys (Riordan et al. 2018).

Legend has Ecological Sections;
black lines are subsections.

Ecological Section/subsection:
Central California Coast 261A: k
Southern California Coast 261B: a,b,e-j
Southern California Mountains and Valleys M262B: a,d,f,j,k,l,n,o
Mojave Desert 322A: g (bordering M262B)



C. Life history, life form

Perennial, long-lived, woody evergreen shrub.

D. Distinguishing traits

A generally multistemmed, tall, evergreen shrub with a rounded canopy usually 2 to 5 m tall (occasionally to 6 m) and often as wide as tall with smooth greyish-brown to reddish bark; twigs frequently reddish (McMinn 1939, Munz & Keck 1968). Broken twigs ooze a thick milky, resinous sap. Leaves lance-oblong, alternate, pliable when young but leathery when mature, green, lighter green below, and aromatic; blades 4 to 10 cm long and 2 to 4 cm wide, folded along the midrib and attached to slender petioles 1 to 3 cm long; leaf veins prominent, pinnate but branched toward the entire margins. Dense, 5 to 15 cm long branched panicles from the tips of branches produce many white to cream flowers; the five-parted flowers about 1 mm wide are bisexual or unisexual and the sepals are persistent in fruit (Barkley 1937, Miller & Wilken 2017). Fruit is a glabrous, berry-like drupe, about 2 mm long with a whitish waxy bloom. New, flushing leaves start reddish, becoming bright green, fading to a dull green as they thicken. Many plants produce exclusively male flowers (polygamodioecious) (Barkley 1937).

Some confuse this plant with sugar bush (*Rhus ovata*). The leaves of sugar bush are much thicker, darker green, wider, and not as obviously folded along the midrib. The fruits are also larger, hairy and flattened, and the flowers are in smaller inflorescences and have pink to red sepals with ciliate margins.

E. Root system, rhizomes, stolons, etc.

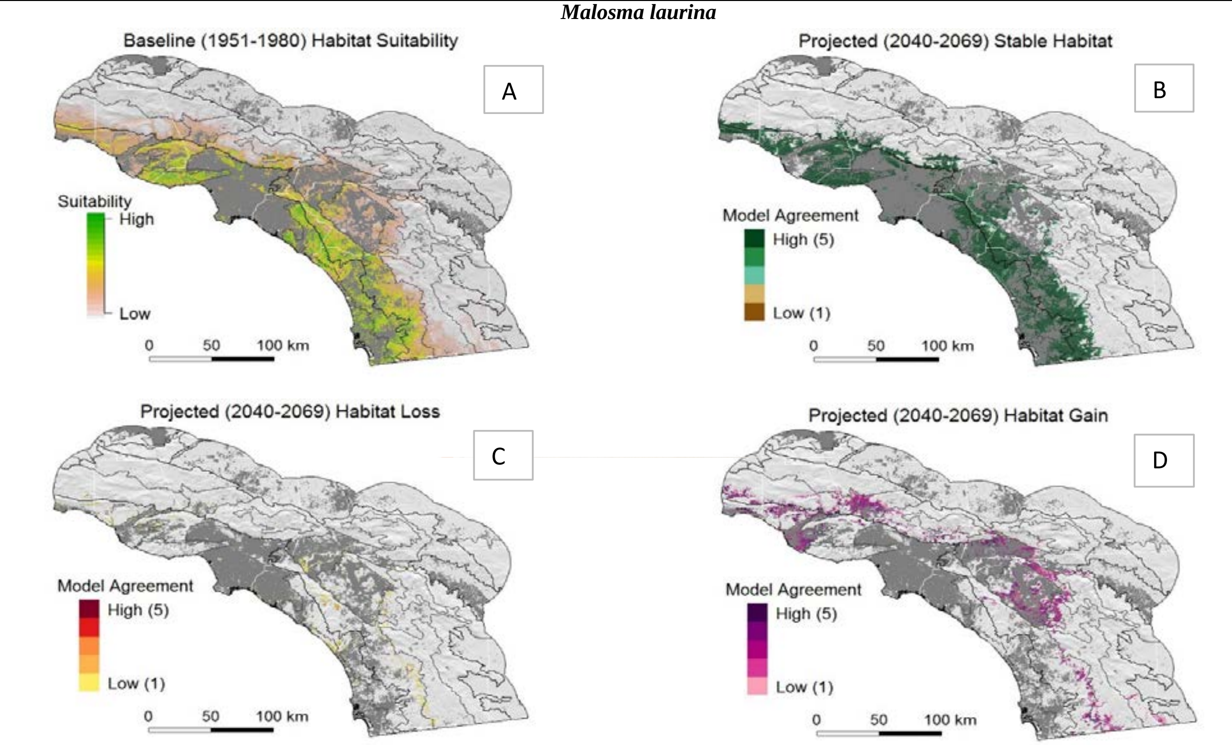
Branched tap root, woody, fibrous.

F. Rooting depth	Deep-rooted. *Malosma laurina* can produce roots over 6 m deep, especially in fractured bedrock (DeSouza et al. 1986, Canadell et al. 1996). Along a road cut, laurel sumac roots were found 13.2 m deep. Thomas & Davis (1989) measured tap roots of resprouting plants to >5.4 m, and seedling tap roots to 0.12 m by the end of the first summer of growth.
IV. HABITAT	
A. Vegetation alliances, associations    	*Malosma laurina* is a significant member of many vegetation alliances, growing in nearly monospecific stands to scattered in coastal sage scrub, chaparral, alluvial scrub, desert scrub and woodland associations (Howard 1992, Sawyer et al. 2009). Within the *Malosma laurina* alliance, major associations include: *Malosma laurina - Artemisia californica, Malosma laurina - Rhus ovata - Ceanothus megacarpus, Malosma laurina - Eriogonum cinereum, Malosma laurina - Eriogonum fasciculatum, Malosma laurina - Eriogonum fasciculatum - Salvia apiana, Malosma laurina - Eriogonum fasciculatum - Salvia mellifera,* and the *Malosma laurina - Tetracoccus dioicus* assoiciation (Sawyer et al. 2009). Within coastal scrub it maybe dominant to co-dominant with a diversity of shrubs, including: *Artemisia californica , Encelia californica, Eriogonum cinereum, E. fasciculatum, Hesperoyucca whipplei, Heteromeles arbutifolia, Keckiella antirrhinoides, Malacothamnus fasciculatus, S. mellifera, S. apiana, Rhus ovata, R. integrifolia,* and *Xylococcus bicolor,* and after fire it is commonly associated with *Acmispon glaber* (Howard 1992, Sawyer et al. 2009). Sawyer et al. (2009) report it as common in the following coastal scrub alliances and associations: the *Malacothamnus fasciculatus* alliance, especially in the *Malacothamnus fasciculatus - Malosma laurina* association; within the *Salvia leucophylla* alliance in the *Salvia leucophylla - Malosma laurina* association; within the *Salvia leucophylla* alliance in the *Salvia leucophylla - Malosma laurina* association; within the *Salvia mellifera* alliance in the *Salvia mellifera - Malosma laurina* association; and within the *Encelia californica alliance* in the *Encelia californica - Malosma laurina - Salvia mellifera* association. In chaparral and mixed chaparral, laurel sumac often occurs with *Ceanothus crassifolius, C. megacarpus, C. spinosus, Adenostoma fasciculatum, Arctostaphylos glauca,* and *A. glandulosa* ; within the *Cercocarpus betuloides* alliance, it is in the *Cercocarpus betuloides - Malosma laurina - Artemisia californica* association; and in the *Heteromeles arbutifolia* alliance in the *Heteromeles arbutifolia - Malosma laurina* association (Sawyer et al. 2009). In maritime succulent scrub it occurs in the *Opuntia littoralis* alliance, especially the *Opuntia littoralis - Eriogonum fasciculatum - Malosma laurina* association (Sawyer et al. 2009). In desert scrub laurel sumac occurs with *C. perplexans, Prunus fasciculata, Dendromecon rigida,* and *Fremontodendron californicum* (Sawyer et al. 2009). In woodlands, laurel sumac often occurs with *Prunus ilicifolia, Quercus engelmannii, Q. lobata, Q. agrifolia, Juglans californica, Platanus racemosa,* and *Sambucus nigra* ssp. *caerulea* .
B. Habitat affinity and breadth of habitat	Slopes, canyons, alluvial fans and well-drained outwash deposits, and ephemeral drainages in lower elevation chaparral, coastal sage scrub, and alluvial scrub in areas lacking regular frost (McMinn 1939, Munz & Keck 1968, Sawyer et al. 2009). Across an index of habitat moisture from 0 to 230 (with 0 the most xeric), laurel sumac was associated with the xeric end of the spectrum, increasing to between 80 to 90, then decreasing sharply in more mesic situations (Westman 1981). Plants occur on both north and south-facing exposures in coastal sage scrub (Kirkpatrick & Hutchinson 1980). Westman (1981) characterizes laurel sumac as a subtropical xerophyte occurring exclusively in the xero-thermo Mediterranean zone, where it avoids low temperature minima and high water-holding capacity of soil and favors soils with high levels of exchangeable potassium and high accumulations of leaf litter. Furthermore, a strong correlation between minimum yearly temperatures and abundance was found for laurel sumac for sites throughout its range in California and Mexico (Misguez 1990 in Boorse et al. 1998), suggesting temperature minima strongly influence the distribution of this species. In field tests, Pratt et al. (2005) found seedlings were injured at -4ºC and died at -7.2ºC, compromising its ability to colonize colder sites. Mature plants suffer branch dieback during cold waves (Howard 1992). Pratt et al. (2005) found the dieback is caused by freeze-induced xylem embolism, and upon freezing and thawing the leaves are more susceptible than branchlets to injury and death.
C. Elevation range	Sea level to 1000 m, occasionally to 1,200 m (CCH 2016). Occurrences at the upper end of this range are generally on mid to upper slope positions, away from cold air drainage or sites with prolonged freezing temperatures (Davis et al. 2007a).
D. Soil: texture, chemicals, depth	Grows in shallow to deep, generally coarse-textured soils or, if fine, in well-drained locations. In one survey, it occurred primarily on sandstone, shale, volcanic, and conglomerate soils, less so on granite/ diorite and alluvial soils, but not on serpentine, limestone, or unconsolidated sand (Westman 1981). Tends to occur where exchangeable potassium levels are higher (see IV B. Habitat affinity). In studies examining the effects of atmospheric nitrogen deposition in coastal sage scrub, *Malosma laurina* was one of the few native shrubs to respond favorably to added soil nitrogen (Valliere 2016).

E. Precipitation	Occurs primarily in the Mediterranean climate zone with cool to cold moist winters and warm to hot dry summers. Plants typically grow in areas of ecological subsections with 10 to 30 in precipitation, falling as rain. For ecological sections occupied by laurel sumac, annual normal precipitation ranges from 14 to 50 (350 to 1270 mm) in the Central California Coast (261A), 10 to 25 in (250 to 640 mm) in the Southern California Coast (261B), and 10 to 40 in (250 to 1020 mm) in the Southern California Mountains and Valleys (M262B), but the higher precipitation zones are at colder, higher elevations where laurel sumac does not occur.
F. Drought tolerance	Tissues are relatively sensitive to drought, but plants remain active during summer drought by extracting water with their deep root systems and nutrients from lignotubers (DeSouza et al. 1986). After fire, plants take advantage of deep roots and nutrient storage from lignotubers to resprout and grow into the dry season. The deep roots may also buffer plants from some of the seasonal aspects associated with low soil moisture. Predawn water potentials of adult plants are fairly high and stable across seasons, rising only a bit during the rainy season (Frazer & Davis 1988) and not in response to summer rainfall events (Minnich 1985). However, predawn water potential in seedlings decreases (becomes more negative) as the upper soil profile becomes drier in summer, then increases to high levels in the fall-winter rainy season (Frazer & Davis 1988), a finding mirrored in leaf turgor potential and osmotic potential (Saruwatari & Davis 1989). Although drought tolerant, laurel sumac can be negatively affected by prolonged, severe drought. Predawn water potentials in mature plants can become significantly more negative in severe drought (Venturas et al. 2016). Acute, extremely low water potentials (-4 MPa) may cause xylem cavitation (embolism) and dieback of branches. Although many mature plants survived the record 2016 drought (e.g., Venturas et al. 2016), extensive dieback was later observed in some areas. Stephen Davis and colleagues (pers. com.) found that when plants suffered persistently low water status over several years (e.g., 2014-2016), they became susceptible to enhanced growth of an endophytic fungus in the xylem and phloem (see VII. B. Herbivory, seed predation, disease). Wood traits are consistent with traits seen in more arid environments, including lack of tracheids, shorter vessel elements that lack helical sculpturing, and rays with resin canals (Young 1974).
G. Flooding or high water tolerance	Can withstand infrequent floods in rapidly draining alluvial outwash areas (A. Montalvo pers. obs). Not tolerant of wetland soils.
H. Wetland indicator status for California	None
I. Shade tolerance	Full sun, shade tolerant. Seedlings may survive better in shaded microsites created by resprouting shrubs (Thomas & Davis 1989). Saplings eventually grow through the canopy of sheltering plants.

V. CLIMATE CHANGE AND PROJECTED FUTURE SUITABLE HABITAT

Malosma laurina



A. Species Distribution Models (SDM forecasts from 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 laurel sumac could maintain much of its suitable habitat under 21st century climate change. Assuming a future of continued high greenhouse gas emissions, Riordan et al. (2018) predicted 95–100% of baseline habitat for laurel sumac in southern California would remain suitable (stable) under mid-century climate conditions across future climate scenarios from five different general circulation models (GCMs) (V. A. Fig. B). Low to moderate gain in suitable habitat (7–33%) exceeded loss under all five climate scenarios (V. A. Figs. C-D), with most gains at higher elevations. Expansion of the species range up elevational gradients would make sense in places where temperature minima increased enough for seedlings to escape mortality from freezing (see IV B. Habitat affinity; Davis et al. 2007b). A previous study by Riordan & Rundel (2014) predicted slightly higher losses for the species: 10–13% habitat loss at mid-century rising to 17–23% at the end of the 21st century. In contrast, Principe et al. (2013) predicted greater habitat losses with only 40–50% of current habitat remaining suitable by mid-century and negligible suitable habtat gain. Land use, altered fire regimes, and their interaction with climate change could negatively affect laurel sumac, even if projected loss in habitat from climate change alone is relatively low. In southern California human activity is the primary driver of fire (Keeley & Syphard 2016) with fire ignitions and fire frequency increasing with human population growth (Syphard et al. 2009). Laurel sumac is a facultative seeder resistant to higher fire frequencies, regenerating by both resprouts and seeds after fire (see VI. D. Regeneration after fire or other disturbance) (Lucas et al. 2013, 2017; Zedler et al. 1983). However, seedlings are more susceptible to water stress than resprouts during postfire summer drought (Frazer & Davis 1988, Pratt et al. 2014), and too high fire frequencies can contribute to the conversion of mixed chaparral and coastal sage scrub to annual grassland (Haidinger & Keeley 1993, Talluto & Suding 2008). In areas where warming decreases the frequency of freezing in valleys, laurel sumac may migrate downhill (Stephen Davis pers. com., Pratt et al. 2005, Davis 2007b, Esler et al. 2018). The high level of habitat conversion and fragmentation throughout the species' range creates barriers to dispersal and gene flow that could negatively affect the adaptive capacity and ability of the species to respond to changing conditions. Much of the coastal, low elevation suitable habitat of laurel sumac in southern California has been developed. Riordan and Rundel (2014) caution that land use may compound projected climate-driven losses in suitable habitat in southern California shrublands. They predict that the combination of projected land use and climate change could cause over 50% loss of currently suitable habitat for laurel sumac by the end of the 21st century (Riordan & Rundel 2014).
C. SDM caveat (concerns)	The five 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, 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	Most laurel sumac seedlings emerge in the first year after wildfire (Frazer & Davis 1988; Keeley 1991, 1998; Keeley et al. 2006) after the onset of winter rains. Keeley & Soderstrom (1986) documented that seedlings more than doubled between March and June at three postfire sites along an elevational gradient, suggesting most seedlings emerge late winter to mid spring. Seedlings also emerge at low densities in good rainfall years in unburned areas (A. Montalvo pers. obs., Keeley 1987). Keeley et al. (2006) found twice the seedling emergence in coastal compared to inland post-fire sites, that over a five-year period 90% of the seedlings emerged in the first year after fire, and that about 4% of coastal seedlings and 10% of interior seedlings survived to the fifth year.

B. Growth pattern (phenology)  Leaf flush in spring.	Plants are fast growing but few seedlings reach flowering size by the fifth year (Keeley et al. 2006). Growth and flowering of laurel sumac tends to be later in the growing season than in related species of *Rhus*, especially in the inland portions of its home range, likely because leaves are more sensitive to frost and are killed by freezing temperatures (Boorse et al. 1998, Pratt et al. 2005). Under controlled laboratory studies, Hellmers & Ashby (1958) found more growth of both shoots and roots at warmer daytime/ nighttime temperature combinations (23ºC/17ºC, 23ºC/26ºC, and 30ºC/17ºC) compared to cooler daytime/ nighttime temperature combinations (17ºC/4ºC, 17ºC/17ºC, 23ºC/4ºC, or 23ºC/10ºC). Seedlings are more sensitive to freezing temperatures than resprouts or mature plants (Boorse et al. 1998, Pratt et al. 2005); this may deter laurel sumac from colonizing colder, higher elevation sites that experience frequent frost. From northern Baja California to the northern part of the species range, leaves flush in spring, generally late March to June, followed by flowering primarily in late May and June (Minnich 1985, Perlmutter 2004); however, flowering occurs earlier in central to southern Baja California and may be bimodal. Fruits mature through the summer, becoming ripe and dry mid-to-late summer. Plants may flush leaves rapidly after summer storms with shoot elongation continuing until winter (Minnich 1985).
C. Vegetative propagation	There are no specialized vegetative propagules (not clone-forming), but plants produce a basal burl (lignotuber) at the root crown (DeSouza et al. 1986) and can resprout repeatedly.
D. Regeneration after fire or other disturbance	Facultative seeder− seeds germinate and plants resprout after fire (Keeley et al. 2006). Success of resprouts was lower after high severity fire in one study and unrelated to fire severity in another (Keeley 2006, Keeley et al. 2008). After tops of plants are killed by fire, plants resprout from basal lignotubers (Howard 1992). Thomas & Davis (1989) found that burned plants began to resprout within 15 days after fire and that survival of resprouts greatly exceeded survival of seedlings. High percentages of top-killed plants resprout successfully and growth occurs through December with adequate rainfall; resprouted plants can produce flowers within two years (Howard 1992). In a study of 90 sites after a series of 1993 fall fires, Keeley (1998) found over 90% of laurel sumac resprouted and there was an average of 60 seedlings per prefire shrub. In a subsequent study comparing coastal and interior postfire sites, Keeley et al. (2006) found an average of 92% and 97% of plants resprouted and an average of 240 and 90 seedlings per parent for coastal versus interior sites, respectively. Seedlings suffered steep declines in survivorship that were faster for coastal compared to inland populations. Survival of seedlings to the fifth year was similar for chaparral and coastal sage scrub sites (25 and 27 plants/ha, respectively). Successful recruitment from seeds is highly dependent on rainfall patterns. Mortality of seedlings tends to be very high in low rainfall years and during the summer drought with success mostly in the odd, high rainfall year (Frazer & Davis 1988, Howard 1992). Post-fire seedlings are more sensitive to freezing-induced xylem embolism than resprouts as well (Davis et al. 2007b).
E. Pollination	Laurel sumac is used by the non-native honey bee, *Apis mellifera* (Goltz 1987). Pelmutter (2004) observed non-native honey bees, bumblebees (*Bombus* sp.) and hover flies (Syrphidae) visiting flowers.
F. Seed dispersal	Dispersed by a variety of birds and small mammals (Brizicky 1962, Rowe & Blazich 2008, Sawyer et al. 2009).
G. Breeding system, mating system	Plants are "polygamodioecious" and outcrossing (see III. D. Distinguishing traits). Perlmutter (1998) studied a population of plants in Ventura County and found that three types of flowers are produced (pistillate- fertile female organs, staminate- fertile male organs, and bisexual flowers) with the following trends. Plants are predominantly functionally dioecious (succeed as male or female). Some plants produce all male flowers, some all female flowers, while others produce mostly male flowers with up to 25% bisexual flowers. Plants with bisexual flowers produce only outcrossed fruit and many fewer fruits than plants with all female flowers. Female plants produce the most fruit. Pollination experiments showed that self-pollen does not produce fruit, suggesting plants are self-incompatible and cross pollination is required for fruit set. Perlmutter (2004) found only 30% of one population to be functionally female.
H. Hybridization potential	No reports of hybridization found.
I. Inbreeding and outbreeding effects	No studies found. These plants are highly outcrossing and likely to suffer negative effects of inbreeding in small populations if only close relatives are available as mates.

VII. BIOLOGICAL INTERACTIONS

A. Competitiveness	Most competition is likely for space and water during early seedling growth. Surrounding shrubs may provide shelter and act as nurse plants during early seedling growth (see IV. I. Shade tolerance). Seedlings are unlikely to compete well with non-native grasses. The increase in plants in areas grazed by livestock (VII. C. Palatability) suggests competitive release.

B. Herbivory, seed predation, disease	**Herbivory:** At a site in the Santa Monica Mountains, Frazer & Davis (1988) found 17% of seedlings with herbivore damage by the end of the growing season. Herbivory of resprouts by vertebrates was observed after they exceed 50 mm (Thomas & Davis 1989). Most herbivore damage was thought to be by deer. **Disease:** Using controlled pot experiments, Stephen Davis (pers. com.) found Laurel sumac is predisposed to fungal infection by the endophytic fungus *Botryosphaeria dothidea* when severe and prolonged drought causes persistently low water status (see IV. F. Drought). At abnormally low water potentials, plants may suffer carbon starvation and a reduced ability to transport carbon to wall off fungal growth. *Botryosphaeria* cankers form on branches and twigs, which die back. The spores are released into the air and spread easily. Unstressed plants can be colonized by the fungus and remain symptomless.
C. Palatability, attractiveness to animals, response to grazing	Classified as useless for livestock (Sampson & Jesperson 1963). Plants may increase substantially in heavily grazed areas (Howard 1992).
D. Mycorrhizal? Nitrogen fixing nodules?	No studies found. No reports for *Malosma* or species of *Rhus* . The roots of some species of *Rhus* produce anitmicrobial or other medicinally active compounds (NAE 2016 database).

VIII. ECOLOGICAL GENETICS

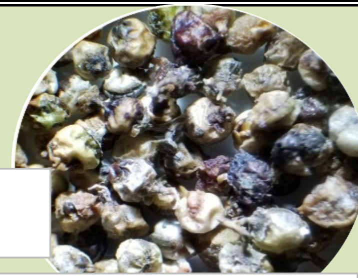
A. Ploidy	No record found. Taxa in the related genus *Rhus* have n = 15 chomosomes with no reports of variation (Löve 1969, 1985; Parfitt et al. 1990).
B. Plasticity	No specific studies found, but see VI. B. Growth pattern for possible plasticity in flowering time, and VII. C, below regarding environmental influences on vascular tissue and other traits that may affect cold tolerance.
C. Geographic variation (morphological and physiological traits)	Young (1974) examined wood traits of laurel sumac from six populations ranging from Santa Barbara Co, western Riverside Co., Cedros Is. Baja California, and mainland Baja California. He found north to south trends in vessel diameter and vessel-element length. Such traits are expected to translate into functional differences in xylem hydraulics and vulnerability to cavitation (Jarbeau et al 1995, Jacobsen et al. 2016). On a smaller geographic scale, Jacobsen et al. (2005, 2014) did not find variation in dehydration vulnerability between plants measured at coastal and inland areas of the Santa Monica Mountains. There is also variation among populations in timing of flowering (see VI. B. Growth patterns) and in sensitivity to freezing temperatures (Minnich 1985). Boorse et al. (1998) found that plants from a coastal, warm site in the Santa Monica Mountains (where winter temperatures rarely drop below 0ºC) were more susceptible to freezing temperatures than plants from a colder inland site (where temperatures reach -8ºC to -12ºC in winter) where laurel sumac was rare. Furthermore, plants from the colder site differed in their response to cold in different seasons while plants from the warmer site showed no difference, indicating that only one of the populations was able to acclimate. It is not known if these differences among populations in anatomy, phenology, and temperature sensitivity are primarily genetically determined, developmentally plastic responses to the environment, or both. The nature of such differences could be determined if plants from different populations were grown together in several common environments.
D. Genetic variation and population structure	No studies found.
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 determined by environmental influences during a plants lifetime, by genetic differences, or both (see VIII. C. Geographic variation).
G. Translocation risks	There are significant risks of maladaptation if plants are moved to colder winter environments (see VI. B. Growth patterns; VIII. C. Geographic variation). 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, no-to-low-frost winter temperature regimes (see VIII. C. Geographic variation).

IX. SEEDS

Seed image by John Mcdonald (RSA Seeds 2017).
Scale for large image:

2 mm

2 mm



Clean, dry fruits with fruit wall intact.
Photo by A. Montalvo.

A. General

The small, nearly globose drupes (referred to as seeds) dry on the plant and are about 2 to 2.5 mm long. Seeds are slightly flattened, lack endosperm, and are enclosed within a hard, persistent endocarp (Rowe & Blazich 2008). The outer, papery fruit wall is glabrous and covered with a waxy bloom.

B. Seed longevity

Long-lived. Everett (2012) reports seeds germinating after nine years in storage. A single seed lot stored under cool dry conditions and treated with boiling water before planting achieved 25% germination the first year (fresh seeds), 26% germination at 3.5 years, and 14% germination at nine years (A. Montalvo pers. obs.). Average individual seed mass for female plants was 2.18 mg (Perlmutter 2004).

C. Seed dormancy

Seeds have physical dormancy and the seeds are often scarified by the heat of fire (Keeley 1991).

D. Seed maturation

Seeds mature over the hot summer season, becoming ripe and dry August through September (VI. B., A. Montalvo pers. obs.).

E. Seed collecting and harvesting

Fruits ready to collect.
Photo by A. Montalvo.

Collect fruits primarily from August to October after drupes become dry. Hand pick or cut off clusters of fruits into open containers or breathable, cloth sacks. Removing fruits from the stems is best done back at a facility by rubbing over a screen (A. Montalvo pers. obs., see IX. F, below).

F. Seed processing

For small collections, extract seeds from dry clusters and twigs by rubbing through a 1/4 in screen, then screen further to remove debris. Most good seeds are captured in a 2 mm screen. It is not necessary to remove fruit walls completely for treating seeds and planting (A. Montalvo pers. obs.). To clean down to seeds, drupes can be rubbed over a #18 screen to break up fruit walls and remaining debris and hollow seeds can be blown off at intermediate blower speeds that vary with seed blower (Wall & Mcdonald 2009).

G. Seed storage

As in the related *Rhus,* seeds of laurel sumac can remain viable for years if placed in dry storage in sealed containers at 0 to 5°C (Rowe & Blazich 2008).

H. Seed germination

Seed germination can be improved with heat treatment, but not all seeds need scarification to germinate. In a series of heat trials, Wright (1931) found that the highest germination (44 to 52%) occurred after exposing seeds for 5 min to 180-200ºF, 200-220ºF, and 220-240ºF. He also found that 54% and 56% of seeds germinated when exposed for 5 and 15 min, respectively, to 212ºF compared to 17% in unheated controls. Germination decreased to 30% for longer exposures. Keeley (1987) found that in light, about a third of seeds germinated in the control treatment (no heat scarification) and for seeds exposed to 70ºC for 1 hr or 100ºC for 5 min; in dark half as many seeds germinated compared to seeds exposed to 70ºC for 1 hr or 120ºC for 5 min suggesting light improves germination. Schmidt (1980) recommended treating with hot water and leaving seeds to soak for 24 to 48 hr. Pouring boiling water over seeds and soaking 5 min resulted in 25% compared to 0% germination for unheated controls (A. Montalvo pers. obs.). For hot water-treated seeds planted in early-fall to late-winter, seedling emergence began after about four to five weeks and continued for several months. On another see lot, 25% germination by the third month of testing was also found after boiling water was poured over seeds and seeds were left to soak overnight.

I. Seeds/lb

About 130,000 cleaned seed per pound; about 90,000 fruits per pound (Rowe & Blazich 2008).
Average live seed per bulk pound = 85,400 and seeds per PLS lb = 125,000 (S&S Seeds 2017).

J. Planting	**Horticulture:** Heat scarified (see H. Seed Germination) or untreated seeds planted 1/8 to 1/4 in deep in flats in fall through winter tend to emerge slowly under ambient temperatures. Treating seeds can help to avoid selection against seed dormancy. **Restoration:** Container plants of various sizes have been used successfully. Studies are needed on success of seeding with heat-treated and untreated seeds. If planted in the fall to early winter, survival of out-planted container plants can be very high when rainfall is supplemented with irrigation during the first year (A. Montalvo pers. com.). On Santa Catalina Island, 17% of out planted seedlings survived in unwatered plots compared to 37% in irrigated plots (Stratton 2004).
K. Seed increase activities or potential	None found. This species would do well in a seed orchard, but the large size of plants and functional dioecy would require a large area with many plants to achieve high yield and genetic diversity.
X. USES	
A. Revegetation and erosion control	Commonly used for erosion control and land rehabilitation in southwestern California (Newton & Claassen 2003).
B. Habitat restoration	In restoration, container plants are often used with irrigation until established (A. Montalvo pers. obs.). If planted in late fall to early winter, plants may be sufficiently established by the first summer in a good rainfall year. If plants are started in deep pots to allow growth of the tap root, less irrigation may be needed (see X. C. Horticulture). Howard (1992) found planted seedlings had high survival, but this is likely dependent on having good taproot structure and rainfall or irrigation patterns. In areas seeded with these slow-to-germinate seeds (see IX. H. Seed germination), glyphosate herbicide can be used after the first weed seedlings emerge because seeds of many of the problematic weeds germinate much faster after the first rainfall event (Balshor et al. 2016). In a screening for heavy metal phytoremediation, Poltorak (2014) found laurel sumac accumulates silver from the soil in its roots but the practicality of its use was not discussed.
C. Horticulture or agriculture Newly flushing leaves are reddish and become bright green when fully expanded. 	**Growing plants:** Plants are best grown from seeds; cuttings can take up to a year to root (Mirov 1940) and seeds provide enhanced genetic diversity. Untreated seeds start to germinate in 18 to 21 days and continue to germinate over one to two months but hot water treatment may produce more seedlings (Everett 2012). Although Everett found old seeds (e.g., stored 9 yrs) germinated, they produced weaker seedlings. Treated seeds (see IX. H. Seed germination) can be sown 1/8 to 1/4 inch deep in seedling flats and transplanted to larger containers in well-draining soil after the first true leaves appear. Plants should not be overwatered (allow to dry down between watering events). Roots of plants started from seed in late winter can fill deep 1-gallon pots by late summer (4" wide x 13.5" deep, ribbed, open bottom). Deep pots better accommodate the growth of tap roots. In one trial, laurel sumac had over six times higher survival 4 years after outplanting when plants were initially grown in 1-gallon deep pots compared to 2" x 2" x 5" deep liners (Burkhart 2006). **Landscaping:** In its native climate zone, plants do well as part of privacy screens with other tall evergreen native shrubs such as *Heteromeles arbutifolia, Prunus ilicifolia,* and *Rhus ovata* . They provide shady cover for birds, and can be trimmed-up or hedged if desired. The green foliage is attractive all year long as are the reddish flushing leaves. Plants need no added water after they are established, but they tolerate infrequent, deep summer water (A. Montalvo pers. obs.). There are differing anecdotal accounts about how quick the plants are to ignite when exposed to heat of fire. Laurel sumac is included on some municipal lists of species acceptable for planting in fuel modification zones (County of Riverside 2013, San Diego County date n.d.) but on the do not plant list for others (e.g., Santa Monica Mountains Fire Safe Alliance 2010). Schmidt (1980) considered laurel sumac to be fire resistant. Within 100 feet of homes in high fire-danger zones, wide spacing of specimens, pruning dead branches (fuel ladders) and removing lower branches can increase fire safety. Occasional deep irrigation of plants near homes can hydrate the plants and reduce flammability. **Seed increase:** Seed orchards are not practical owing to the large size of plants and low ratio of plants with female flowers (~30%, Perlmutter 2004) . Seed can be readily collected from natural stands of plants.
D. Wildlife value  California quail takes cover.	Plants produce high quality cover for birds, small mammals, bobcats, cottontail rabbits, and other wildlife. 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.). Laurel sumac is especially consistent and important for roosting cover and elevated refuge for California quail (Vanderplank 2011). Black-tailed deer occasionally browse resprouts and seedlings of *Malosma laurina* (Frazer & Davis 1988), and it is reported to be a common browse plant of mule deer in San Diego County (Pious 1989 in Wolcott et al. 2014). Fruits are consumed by birds such as California quail and wrentits (Conrad 1987) and likely by small mammals (Sawyer et al. 2009).

E. Plant material releases by NRCS and cooperators	None.
F. Ethnobotanical	The Barareño and Inseño Chumash are reported to have considered *Malosma laurina, Rhus ovata* and *R. integrifolia* as a single category of plants (Timbrook 2007). The fruits were pounded, dried and eaten raw after winnowing away the "chaff" and a tea to treat dysentery was prepared by boiling bark of the roots in water.
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XII. CITATION	Montalvo, A. M., E. C. Riordan, and J. L. Beyers. 2017. Plant Profile for *Malosma laurina.* 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)	https://www.fs.fed.us/database/feis/plants/shrub/mallau/all.html
Calflora	https://www.calflora.org/cgi-bin/species_query.cgi?where-calrecnum=5348
Jepson Interchange	https://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?MALA6
Jepson eFlora (JepsonOnline, 2nd ed.)	https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=32551
USDA PLANTS	https://plants.usda.gov/core/profile?symbol=MALA6
Native Plant Network Propagation Protocol Database (NPNPP)	https://npn.rngr.net/propagation
Native Plants Journal	https://npn.rngr.net/journal
Native Seed Network (NSN)	https://www.nativeseednetwork.org/
GRIN (provides links to many resources)	https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=452069
Flora of North America (FNA) (families covered)	http://beta.floranorthamerica.org/Families_Included
Native American Ethnobotany (NAE)	http://naeb.brit.org/
Woody Plant Seed Manual	https://www.fs.usda.gov/nsl/nsl_wpsm.html
Rancho Santa Ana Botanic Garden Seed Program, seed photos	http://www.hazmac.biz/050606/050606MalosmaLaurina.html
XIV. IMAGES	Seed images by John Macdonald used with permission from Rancho Santa Ana Botanic Garden Seed Program (RSABG Seed Program), with rights reserved by RSABG. Images may not be used for commercial purposes. All other images by Arlee Montalvo (copyright 2017) unless otherwise indicated with rights reserved by the Riverside-Corona Resource Conservation District (RCRCD). Photos may be used freely for non-commercial and not-for-profit use if credit is provided. All other uses require permission of the authors and the Riverside-Corona Resource Conservation District.

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