




I. SPECIES	<i>Prunus ilicifolia</i> (Nutt. Ex Hook. & Arn.) D. Dietr.	
NRCS CODE: (PRIL)  <p data-bbox="235 792 529 874"><i>P. ilicifolia</i> subsp. <i>ilicifolia</i> in fruit, Aug. 25, 2016.</p>	 <p data-bbox="558 804 1074 874">Flowers of <i>P. ilicifolia</i> subsp. <i>ilicifolia</i>. Note bractless racemes. April 4, 2017, A. Montalvo</p>	 <p data-bbox="1103 804 1657 874"><i>P. ilicifolia</i> subsp. <i>ilicifolia</i>, mature shrub in fruit, August 2015, San Jacinto, CA. A. Montalvo.</p>
A. Subspecific taxa 1. PRILI 2. PRILL	1. <i>P. ilicifolia</i> subsp. <i>ilicifolia</i> (This profile focuses on this subspecies except where indicated.) 2. <i>P. ilicifolia</i> subsp. <i>lyonii</i> (Eastw.) P.H. Raven (Included briefly for context.)	
B. Synonyms	1. <i>Cerasus ilicifolia</i> Nutt. Ex H. & A. (noted by McMinn 1939, Munz & Keck 1968), <i>P. ilicifolia</i> var. <i>ilicifolia</i> (FNA 2017). 2. <i>P. ilicifolia</i> subsp. <i>occidentalis</i> Brandegee; <i>P. occidentalis</i> W.S. Lyon; <i>P. lyonii</i> (Eastwood) Sargent (in FNA 2017); <i>P. ilicifolia</i> var. <i>occidentalis</i> (Nutt.) Brandegee, <i>Cerasus lyonii</i> Eastw. (noted by Munz & Keck 1968)	
C. Common name	1. hollyleaf cherry, holly-leaved cherry, holly-leafed cherry, islay (Spanish name), evergreen cherry 2. Catalina cherry	
D. Taxonomic relationships	There are 57 species of <i>Prunus</i> listed in the Flora of N. America (FNA 2016) and over 200 trees and shrubs worldwide (Bortiri et al. 2006). In a phylogenetic analysis using molecular sequence data (nuclear ITS and chloroplast regions) together with morphological traits, <i>P. ilicifolia</i> clusters with non-Californian <i>P. serotina</i> (east of California), and <i>P. caroliniana</i> (native to se US) in the subgenus <i>Laurocerasus</i> , which also have evergreen leaves and flowers produced in leafless racemes. These species cluster closer to <i>P. virginiana</i> and <i>P. padus</i> than to any of the <i>Prunus</i> native to California (Bortiri et al. 2006). More recently, using nuclear and plastid data, <i>P. ilicifolia</i> was found to cluster closely with a clone of <i>P. emarginata</i> (Zhao et al. 2016). The authors suggest an ancient hybridization event may have resulted in the relatedness these samples.	
E. Related taxa in region	Of the six other species of <i>Prunus</i> in southern California, all are deciduous and only two have ranges and habitats overlapping with hollyleaf cherry (Jepson E-Flora 2016, Rohrer 2016). The six taxa include: <i>P. andersonii</i> A. Gray, a taxon of drier, inland and mostly northern sites; <i>P. emarginata</i> (Douglas) Eaton of the Coast Ranges and Sierra Nevada occurs primarily on along moist slopes and stream banks; <i>P. fremontii</i> S. Watson of rocky slopes and canyons in usually drier, inland locations; <i>P. fasciculata</i> (Torr.) A. Gray of xeric redges, desert slopes, but with a variety in San Luis Obispo Co.; and <i>P. virginiana</i> L. var. <i>demissa</i> (Nutt.) Torr., which can co-occur with <i>P. ilicifolia</i> . <i>Prunus eremophila</i> Prigge is a rare desert taxon outside the range of <i>P. ilicifolia</i> . Other native and naturalized agricultural species of <i>Prunus</i> occur in northern California within the range of hollyleaf cherry.	
F. Taxonomic issues	Catalina cherry was treated as a separate species for many years, including by McMinn (1939) and Munz & Keck (1968) who noted its escape from cultivation on the mainland and tendency to hybridize with hollyleaf cherry.	
G. Other	The shiny, evergreen foliage of these native cherries is prized in horticultural settings. The tall, <i>Prunus ilicifolia</i> subsp. <i>lyonii</i> from the Channel Islands is commonly cultivated within mainland California and has naturalized; the shorter <i>P. i.</i> subsp. <i>ilicifolia</i> has been widely cultivated since at least the early 1900's and can also naturalize (see X. C. Horticulture). Present day distribution on both the mainland and the islands is likely influenced by cultivation. The processed seeds were an important food source for many native tribes, second to acorns (see X. F. Ethnobotanical).	

II. ECOLOGICAL & EVOLUTIONARY CONSIDERATIONS FOR RESTORATION

A. Attribute summary list (based on referenced responses)	<p>Taxonomic stability - medium Longevity - long-lived Parity - polycarpic Flowering age - 5+ yr Stress tolerance - moderate to high Environmental tolerance - broad in adults Reproduction after fire - obligate sprouter Fragmentation history - historical and recent Habitat fragmentation - high at low elevations</p> <p>Seeds - non-dormant, short 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 - high betw. subspecies</p> <p>SDM projected midcentury suitable habitat - 57–100 % stable SDM projected midcentury habitat gain - gain > loss for 4 of 5 models (assuming unlimited dispersal)</p>
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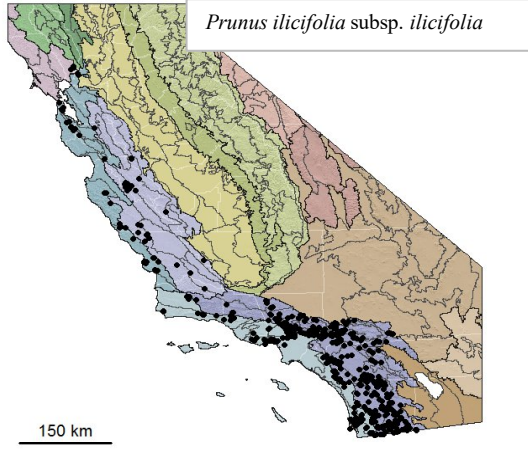
B. Implications for seed transfer (summary)	<p>The long distance seed and pollen dispersal ability, outcrossed mating system, and broad adaptability to soil types suggest this plant will have low sensitivity (low risks) to mixing populations from adjacent Subsections within Ecological Sections. Data from common gardens in contrasting environments are needed to estimate the risk of moving plants long distances (such as among non-adjacent Ecological Sections) along north-south, or east-west environmental gradients. Because hybridization is likely, <i>P. ilicifolia</i> subsp. <i>lyonii</i> should not be planted near natural populations of subsp. <i>ilicifolia</i> or vice versa. The ability to disperse seeds and pollen across mosaics of habitats suggests the species will not need assisted migration. Gains in suitable habitat are likely to occur at elevations above current estimated suitable habitat and in more mesic exposures (see V. A. Species Distribution Models, B. SDM Summary); most loss of suitable habitat is expected to occur at lower elevations where threats from development and shortened fire intervals are highest. Providing habitat corridors for migration of populations from low to higher precipitation areas could improve dispersal.</p>
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III. GENERAL

A. Geographic range	<p>1. Widely distributed in western California and Baja California (FNA 2016) 2. The natural range is restricted to the California Channel Islands and Baja California, but the plant has escaped from cultivation within mainland California (FNA 2016). (not mapped here)</p>
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B. Distribution in California; Ecological Section and Subsection (sensu Goudey & Smith 1994; Cleland et al. 2007)	<p>Map includes validated herbarium records (CCH 2016) as well as occurrence data from CalFlora (2016) and field surveys (Riordan et al. 2018).</p> <p>Legend has Ecological Sections; black lines are Subsections.</p> <p>Ecological Section/Subsection : Northern California Coast 263A: m Sierra Nevada Foothills M261F: e (Tehachapi) Central California Coast 261A: a,e,f,g,j,k Central California Coast Ranges M262A: a,c,e,f,h-k Southern California Coast 261B: a,b,c,e,f,g,i,j Southern California Mountains and Valleys M262B: a-p Mojave Desert 322A: g (bordering M262B)</p>
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Section Code	
261A	M261G
261B	M262A
262A	M262B
263A	322A
M261A	322B
M261B	322C
M261C	341D
M261D	341F
M261E	342B
M261F	□ Salton Sea



C. Life history, life form	<p>Long-lived, polycarpic, sclerophyllous evergreen shrub to small tree. Can live and reproduce for > 150 years (Sawyer et al. 2009).</p>
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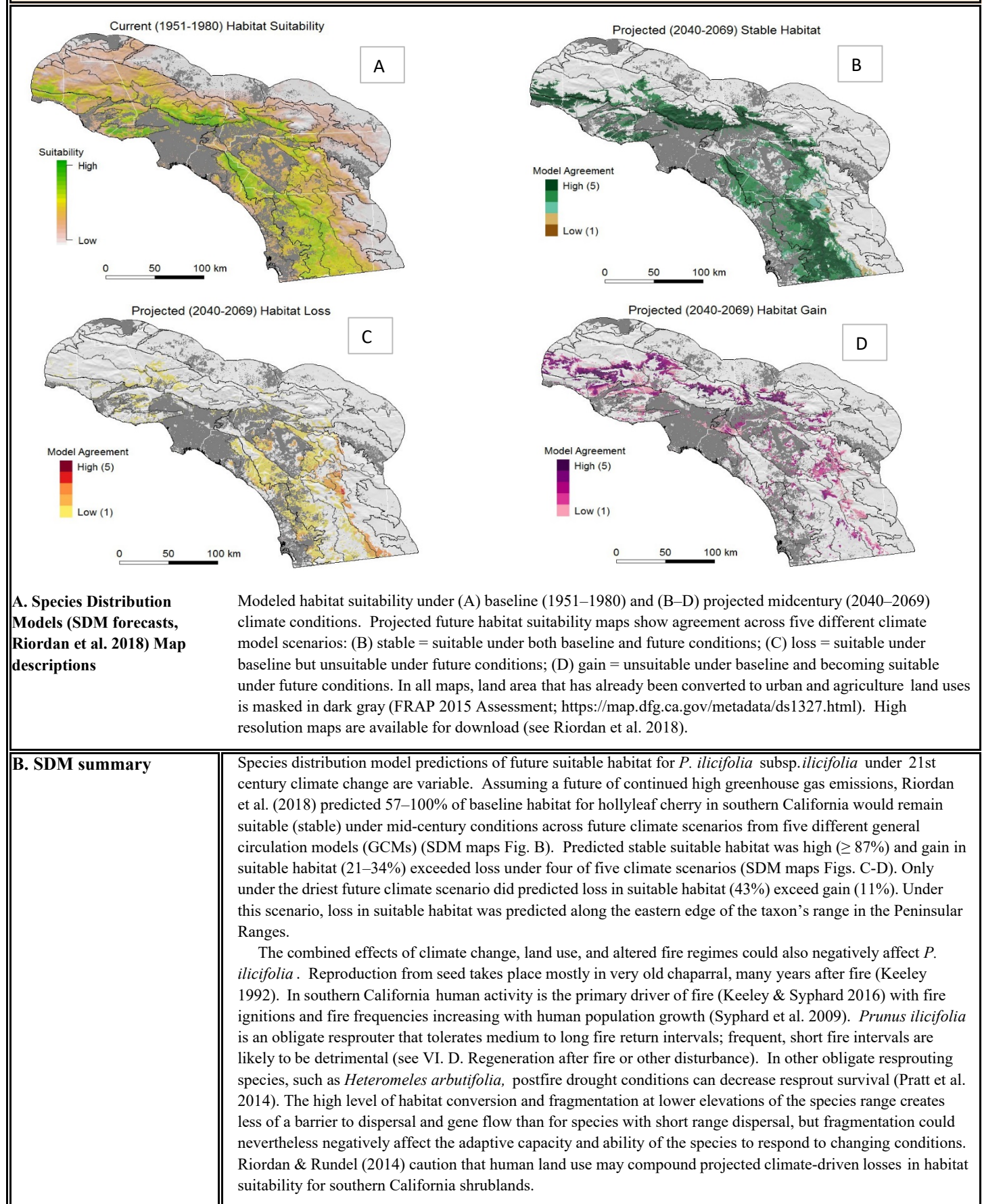
D. Distinguishing traits (McMinn 1939, Munz & Keck 1968, Rohrer 2016)	<p>1. Hollyleaf cherry is a 1 to 8 m tall, evergreen shrub (occasionally small tree) with shiny, dark green, alternate leaves with petioles. The tough, coriaceous blades are ovate to nearly round, 2 to 5 cm long, glabrous, somewhat wavy, with spinose teeth along the margins. The few to many flowers produced in leafless racemes; petals 1 to 3 mm, white to creamy, round oblong about 2 to 3 mm long; sepals green, glabrous, and deltoid, about 1 mm long; ovary superior and mature fruit a round to oval, usually red drupe, 12 to 15 mm long, with a thin pericarp, producing a single seed with smooth, stony, endocarp.</p> <p>2. Catalina cherry differs in generally being a taller tree to 15 m high, with leaf blades usually ovate and margins generally entire and plain; racemes are often longer, with many flowers; drupes are often larger, to 24 mm wide and dark red to nearly black.</p>
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E. Root system, rhizomes, stolons, etc.	<p>The tap root becomes branched within the first few months of growth and the plants develop a spreading root system.</p>
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F. Rooting depth	Minnich (1985) listed <i>P. ilicifolia</i> as shallow-rooted based on the similarity of its water relations to other species known to have relatively shallow roots (e.g., <i>Ceanothus spinosus</i>) in southern California. August water potentials for <i>P. ilicifolia</i> measured by Ackerly (2004) in central California were similar to <i>Heteromeles arbutifolia</i> , which Davis and Mooney (1986) characterized as having intermediate rooting depth. No published measurements of root depth were found, but post-fire resprouting shrubs may have deeper and more extensive root systems than shrubs that are obligate seeders (Jacobsen et al. 2007, Pausas et al. 2016).
IV. HABITAT	
A. Vegetation alliances, associations	<p>Typically occurs within the more mesic chaparral alliances and woodlands.</p> <p>In southern California, hollyleaf cherry is often associated with <i>Heteromeles arbutifolia</i>, <i>Cercocarpus betuloides</i>, and <i>Quercus berberidifolia</i> (Borchert et al. 2004); in San Luis Obispo County it commonly occurs with <i>Aesculus californica</i> (McMurray 1990). In southern California, hollyleaf cherry occurs in many vegetation associations and alliances, and occurs as a dominant or codominant in the following (Sawyer et al. 2009):</p> <p>The <i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i> shrubland alliance (occurs throughout the taxon's range). Associations include: <i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i>–<i>Ceanothus cuneatus</i> association, <i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i>–<i>Fraxinus dipetala</i> association, <i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i>–<i>Heteromeles arbutifolia</i> association, <i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i>–<i>Toxicodendron diversilobum</i>/grass association.</p> <p>Hollyleaf cherry also can be co-dominant in the <i>Aesculus californica</i> woodland alliance and the <i>Juniperus californica</i>–<i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i>/moss association; the <i>Baccharis pilularis</i> alliance within the <i>Baccharis pilularis</i>–<i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i> association, in the <i>Ceanothus megacarpus</i> alliance, especially the <i>Ceanothus megacarpus</i>–<i>Prunus ilicifolia</i> subsp. <i>ilicifolia</i> association; <i>Ceanothus spinosus</i> alliance; <i>Lepidospartum squamatum</i> alliance; <i>Heteromeles arbutifolia</i> alliance; <i>Quercus berberidifolia</i> alliance; and in the <i>Quercus wislizeni</i> alliance.</p>
B. Habitat affinity and breadth of habitat	<ol style="list-style-type: none"> 1. Canyons, slopes, alluvial fans and valleys in coastal and foothill scrublands and woodlands (McMinn 1939, Munz & Keck 1968, Rohrer 2016). Most abundant on NE to N to WNW facing slopes (Hanes 1971, Borchert et al. 2004). 2. Canyons within chaparral and woodlands in the Channel Islands (Rohrer 2016).
C. Elevation range	<ol style="list-style-type: none"> 1. Hollyleaf cherry occurs from sea level to nearly 1,500 m (below 5000 feet) (Munz & Keck 1968, Rohrer 2016). 2. Catalina cherry occurs below 600 m (Rohrer 2016).
D. Soil: texture, chemicals, depth	Occurs in a variety of soil textures and soil depths, but reaches highest density and canopy cover in well-drained to excessively drained soils derived from various types of bedrock including sandstones, shales, and colluvium. Will grow in clay loams, but soil is usually loam to gravelly loam A-horizon and gravelly sandy loam and sandy loam subsoils or over sandstone or other bedrock (Borchert et al. 2004). In the Los Padres National Forest, reported in shallow (to 20 inch), moderately deep (21–40 inch) to deep soils (> 41inch) (Borchert et al. 2004). In the Los Padres National Forest, occurs as dominant or co-dominant shrub in vegetation associated with slightly acidic soil surface pH 5.3–6.8, and only occasionally in pH up to 8.0. Intolerant of heavy clay soils that receive extra moisture (Everett 2012). Tolerates serpentine soils (Sawyer et al. 2009).
E. Precipitation	<p>Hollyleaf cherry occurs in the Mediterranean climate zone of California with cool to cold moist winters and warm to hot dry summers and usually occurs in areas with total annual precipitation ranging from 15 to 50 in (370 to 1280 mm). Within the southern Ecological Sections, many areas experience precipitation normals below 15 in (370 mm). In those sections, hollyleaf cherry tends to occur in the higher precipitation Subsections or higher precipitation elevations within Subsections (see III. B. Distribution in California). In the lower precipitation zones, hollyleaf cherry may be found in mesic microsites (see IV. B. Habitat affinity and breadth of habitat and IV. F. Drought tolerance).</p> <p>Normal Precipitation ranges from 10 to 40 in (250 to 1,020 mm) in the Southern California Mountains and Valleys (M262B), from 10 to 25 in (250 to 640 mm) in the Southern California Coast (261B), from 14 to 50 in (350 to 1280 mm) in the Central California Coast (261A), and from 10 to 30 in (250 to 760 mm) in the Central California Coast Ranges (M262A). Normals range from 20 to 40 in (510 to 1020 mm) in the Sierra Nevada Foothills (M261F) and from 40 to 100 in (1020 to 2540 mm) in the Northern California Coast (263A).</p>
F. Drought tolerance	Drought tolerant, but many studies note that hollyleaf cherry tends to occur in cooler, more northerly-facing, low to mid-elevation sites (e.g., Patric & Hanes 1964, Mooney et al 1974, Sawyer et al. 2009). In studies of stress-induced cavitation, plants were observed to resist cavitation to relatively high negative water potentials (Jacobsen et al. 2007)
G. Flooding or high water tolerance	Withstands periodic/episodic flooding events where water evacuates quickly. Plants occur occasionally in alluvial scrub and in fast-draining young alluvial deposits along watercourses.

H. Wetland indicator status for California	None.
I. Shade tolerance	Plants grow in full sun to partial shade. Seedlings are shade tolerant (see VI. A. Seedling emergence).




V. CLIMATE CHANGE AND PROJECTED FUTURE SUITABLE HABITAT





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 baseline and future habitat suitability should be interpreted with caution and are best applied in concert with knowledge about the biology, ecology, and population dynamics/demographics of the species. They are best interpreted as estimates of exposure to projected climate change, not population-level persistence. 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 impact 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	Seeds disperse in the heat of summer and early fall and are likely to desiccate and die if not dispersed to mesic microhabitats. Successful emergence is most likely for seeds that have been buried in favorable, mesic microsites by secondary dispersers (Borchert & Tyler 2010), and in the protection of nurse plants that shade and protect them from herbivores (Sawyer et al. 2009). Significant seedling emergence and establishment tends to be clumped under shrub canopies on northern exposures (Keeley 1992a). Most seedling establishment appears to be within areas with leaf litter and light shade within older stands of unburned chaparral (Patric & Hanes 1964, McMurray 1990, Keeley 1992a,b).
B. Growth pattern (phenology)	Seedling growth, leaf flush, and most vegetative growth occurs primarily mid-winter into the spring. Plants can reach flowering maturity within five years, or sooner if planted out from containers (McMurray 1990). <i>P. i.</i> subsp. <i>lyonii</i> flowers primarily April and May; <i>P. i.</i> subsp. <i>ilicifolia</i> flowers primarily April to June, peaking in May (Jepson E-Flora 2016). Fruit expansion occurs from late spring to mid summer, becoming ripe mid-August into September in southern California (but may be a month later at higher elevations and latitudes). Anomalous large summer rains can stimulate growth and new leaf production (Minnich 1985).
C. Vegetative propagation	Resprouts after cutting or fire (Hanes & Jones 1967, Keeley 1992 a, b) and may have some layering of branches. No significant vegetative spread.
D. Regeneration after fire or other disturbance	Vigorous resprouting occurs from latent buds of swollen root crowns after cutting or fire (Hanes & Jones 1967, Sawyer et al. 2009). Plants tolerate high severity fire and medium to long fire intervals (Sawyer et al. 2008). See VI. A. Seedling emergence. Few seedlings are found within the first few years after fire because seeds are sensitive to heat and desiccation (Keeley 1992a,b, 1998). However, some seedling establishment may occur after fire if bears, birds or other animals disperse seeds into burned sites (McMurray 1990, Borchert & Tyler 2010). Some recruitment of seedlings from abundant seed production by resprouts two to three years after fire may also occur (McMurray 1990). Seedlings are more likely to occur north-facing slopes of old burns between clumps of rootcrown sprouts (Hanes & Jones 1967).
	
E. Pollination	Insect pollinated. The orientation of stigma and anthers makes most flower visitors likely pollinators if the insects collect pollen and move among plants. Moldenke (1976) notes that syrphid flies and beetles visit <i>Prunus</i> flowers, but the most important and abundant visitors are bees, primarily in the genera <i>Andrena</i> and <i>Bombus</i> . Other bee genera included <i>Halictus</i> , <i>Nomada</i> , and <i>Hylaeus</i> . Frankie et al. (2003) noted that in Berkeley gardens pollen was the reward, that the European honey bee (<i>Apis mellifera</i>) was a common visitor to <i>P. ilicifolia</i> flowers, and native bees visited rarely. Many of the larger solitary bees travel hundreds of meters, and honey bees, bumble bees and some <i>Andrena</i> can travel well over 1 km during foraging bouts (Zurbuchen et al. 2010).
F. Seed dispersal	Seeds of hollyleaf cherry disperse mid-August into October and may be moved long distances by mammals and birds. Coyotes (<i>Canis latrans</i>) and American black bears (<i>Ursus americanus</i>) consume many fruits and travel long distances; defecated seeds have been shown to survive. For coyote, Bullock (1981) found an average of 23.5 seeds in 34 defecated and vomited cohorts. After washing, about 12% of seeds recovered from coyote scat germinated (Silverstein 2005). For black bear, Borchert & Tyler (2010) found an average of 36.1 seeds in scat piles. About 90% of cold stratified seeds recovered from fresh bear scat and 75% of stratified freshly collected seeds were found to germinate. Grey fox also disperses seeds (Sawyer et al. 2009). However, Borchert & Tyler (2010) note carnivores tend to deposit seeds in unfavorable, exposed microsites, making secondary dispersal by rodents potentially important because they move seeds from scat. Dropped seeds may also be buried or scatterhoarded by Pacific kangaroo rats (<i>Dipodomys agilis</i>) or other animals. Scrub jays may also collect, hoard and bury seeds similarly to acorns.

G. Breeding system, mating system	<p><i>Prunus ilicifolia</i> has hermaphroditic flowers (Munz & Keck 1968) as do most North American <i>Prunus</i> (Grisez et al. 2008, FNA 2016). Based on observation of insect visitors, Moldenke (1976) lists <i>Prunus</i> from California as being self-incompatible and primarily outcrossed. No studies of outcrossing rates were found, but studies of European <i>Prunus</i> suggest that plants are likely to be primarily self-incompatible and mostly outcrossing. For example, Spanish populations of <i>P. mahaleb</i> were found to be gynodioecious; some plants produced hermaphroditic flowers, and some only female flowers (Garcia et al. 2005). Even though the plants were partially self-incompatible, outcrossing rates were high and varied from about 0.4 to 1. Females had higher outcrossing rates than hermaphrodites and rates tended to increase as clustering of females or density of plants decreased. In contrast, the wild sweet cherry, <i>P. avium</i>, produces clones, has hermaphroditic flowers (Stoeckel et al. 2006), a gametophytic self-incompatibility system, and outcrossing rates of 100% (Cottrell et al. 2009, Jolivet et al. 2012). In Portugal, <i>P. spinosa</i> also has hermaphroditic flowers and gametophytic self-incompatibility (Nunes et al. 2006). There is research that shows how the self-incompatibility can break down in <i>Prunus</i>, but primarily in high polyploid fruit crop species following hybridization events (e.g., Hauck et al. 2006).</p>
H. Hybridization potential	<p>High potential between subspecies of <i>P. ilicifolia</i> or between cultivated and natural populations when within pollen and seed dispersal ranges (Munz & Keck 1968). No reports of hybridization with other species, but artificial hybrids are common in <i>Prunus</i> cultivated for fruit crops.</p>
I. Inbreeding and outbreeding effects	<p>No studies found. Inbreeding depression was detected in <i>Prunus avium</i> populations in Europe (Stoeckel et al. 2006, Jolivet et al. 2012).</p>
VII. BIOLOGICAL INTERACTIONS	
A. Competitiveness	<p>Seedlings of hollyleaf cherry quickly grow a long taproot provisioned by large cotyledons (see X. H. Seed germination) which can provide a competitive edge, and seedlings grow rapidly. The plants persist in unburned stands for many years (over 100 years) and can establish in the shade and overtop earlier successional, shorter lived shrubs or species that are shade intolerant (Hanes & Jones 1967, McMurray 1990).</p> <p>Bullock (1981) planted seeds at different densities to see how aggregation of seeds during dispersal by carnivores might affect seedling survival and biomass. For 50 seeds planted at different spacing (0, 5, 10 and 20 cm apart), and 2 or 4 seeds planted at 50 cm spacing, the most aggregated plantings had the highest survival of seedlings, but lowest biomass. Natural grafting among roots of different individuals in a planted cohort was common, occurring in 12 of 30 cohorts. This potentially produces multigenic clusters of connected plants.</p>
B. Herbivory, seed predation, disease <div style="text-align: center;">  <p>Larva of <i>Cydia latiferreana</i>. Scale in photo: mm</p> <div style="border: 1px solid black; padding: 2px; width: 40px; margin: 0 auto;">5 mm</div>  <p>Adult <i>Cydia latiferreana</i>. Photos: A. Montalvo.</p> </div>	<p>Herbivory: Foliage is eaten by the larvae of the pale swallowtail butterfly, <i>Papilio eurymedon</i> Lucas (Howe 1975), but plants are seldom affected by insect herbivory. Leaves are also eaten by vertebrate wildlife species (see X. D. Wildlife value); cropping of resprouts after fire can be substantial (J. Beyers, pers. obs.). The leaves may be protected from many insects by toxic compounds. The mature leaves of both subspecies of <i>P. ilicifolia</i> contain cyanogenic glycosides in the form of cyanogenic diglucoside amygdalin (Santamour 1998). Leaves were tested in October and were found to have significant hydrogen cyanide (HCN) content and ratios of prunasin:amygdalin. Feeding trials were not conducted.</p> <p>Seed predation: Although mammals are important dispersers of fleshy fruits (see VI. F. Seed dispersal), their teeth can sometimes puncture seeds and cause desiccation and death. High numbers of seeds have been recovered in bear scat, and about 27% of seeds recovered at one burn site were punctured by mastication. Most punctured seeds failed to germinate (Borchert & Tyler 2010). Insect larvae emerge from mature fruits and may be responsible for most empty fruits that float off during cleaning; the larvae of the widely distributed moth, <i>Cydia latiferreana</i> (Tortricidae: Olethreutinae) consume seeds of hollyleaf cherry as well as other <i>Prunus</i>, oaks, walnuts, and hazelnuts (http://idtools.org/id/leps/tortai/Cydia_latiferreana.htm). Moth in photos identified by Ken H. Osborne.</p> <p>Disease: Fungal and bacterial diseases are sometimes a concern under cultivation and for container plant production (see X. C. Horticulture). Care must be taken to avoid spread of disease from nursery container stock into wild populations.</p>
C. Palatability, attractiveness to animals, response to grazing	<p>Not listed in Sampson & Jespersen (1963) as used by livestock or deer, although other species of <i>Prunus</i> are listed as useless for horses, good to fair for cattle, good to poor for sheep and goat, and good to excellent browse for deer. Plants are apparently palatable to deer and mountain goats (see X. D. Wildlife value). Plants resprout after pruning, cutting, and fire (see VI. D. Regeneration after fire or disturbance). It can be assumed that plants also recover well from limited browsing pressure.</p>

D. Mycorrhizal? Nitrogen fixing nodules?	<p>Hollyleaf cherry is likely to form beneficial arbuscular mycorrhizal associations (M. Allen personal communication). <i>Prunus</i> are known to form mycorrhizal relationships, especially the cherries. For example, roots of <i>Prunus pumila</i> var. <i>bessseyi</i> (L. H. Bailey) Gleason were successfully colonized after inoculation with the arbuscular micorrhizal fungus, <i>Glomus intraradices</i> in the nursery in a soilless mix (60% sphagnum moss:20% perlite:20% vermiculite) when fertilized with a slow release fertilizer (22N:2P₂O₅:11K₂O); inoculated plants had higher survival after planting outside (Meikle & Amaranthus 2008). <i>Prunus ceraciformis</i> forms mycorrhizal associations with abuscular mycorrhizal fungi and ericoid mycorrhizal fungi (Berta et al. 1995).</p>
VIII. ECOLOGICAL GENETICS	
A. Ploidy	<p>No reliable count found. Base chromosome number for genus <i>Prunus</i> = 8 and most species with racemose inflorescences have higher ploidy numbers such as $2n=8x=64$, or $2n=22x=176$. This suggests allopolyploidy where hybridization and polyploidization may have resulted in the origin of some species, including those in subgenus <i>Laurocerasus</i> to which hollyleaf cherry belongs (Zhao et al. 2016). (Note: There is an obviously erroneous note in Parfitt et al. (1990) that reports count of $n=15$ for a sample from San Diego County.)</p>
B. Plasticity	<p>Horticulturists note that the plant can take on different forms depending on its surrounding environment (Bornstein et al. 2005). In shallow, rocky soils the plants grow more tightly and only 3 to 8 feet tall, whereas in heavy, deep soils they can be tree-like to nearly 30 feet tall. These extremes, however, are likely in part from differences in the genetic source. The timing of some growth phases can be plastic. The timing of flowering in hollyleaf cherry does not seem to be affected by unusual summer storms but stem and leaf growth can occur (Minnich 1985).</p>
C. Geographic variation (morphological and physiological traits)	<p>The differences in morphology, natural distribution, and climate for natural populations of the two subspecies are significant (see III. General, A-D), but we found no studies of differences among populations of <i>P. ilicifolia</i> subsp. <i>ilicifolia</i> across its natural range. Ramirez (2015) found differences, measured <i>in situ</i>, between related pairs of wild plants on the mainland (Santa Ana Mtn) and Santa Catalina Island, including hollyleaf cherry and Catalina cherry. The island subspecies had lower leaf toughness and spininess and was eaten more readily by goats; leaf traits associated with adaptation to greater water stress were exhibited by the mainland subspecies. Ramirez (2015) noted that the differences in leaf morphology and physiology could be due both to lack of mammalian herbivory on the island (until recently) and to less arid conditions in the maritime climate of the island, allowing traits conducive to higher rates of photosynthesis to be favored. We do know from horticulture that the main morphological traits are stable in cultivation and under genetic control.</p> <p>Different ways of handling stress were identified among genotypes of another wild cherry (<i>Prunus serotina</i>), a widespread species in North America. Populations vary in regeneration dynamics, habitat, and leaf traits across its range, and when seedlings were grown together in a greenhouse, there were differences in how sun and shade plants responded to drought (Abrams 1994). They found significant genotypic differences in structure of sun leaves and in their responses to drought. Overall, the different populations responded in different ways, suggesting multiple paths of adaptation unique to the different populations.</p>
D. Genetic variation and population structure	<p>No studies found. The dispersal abilities and reproductive biology of hollyleaf cherry suggest the genetic structure would be very low on a local, regional, spatial scale. However, even oaks with high dispensability can develop associations between genotypes and gradients in the environment in heterogeneous California (Sork et al. 2010).</p>
E. Phenotypic or genotypic variation in interactions with other organisms	<p>No studies found.</p>
F. Local adaptation	<p>No studies found.</p> <p>In the related <i>Prunus avium</i>, cultivars have been found to differ in effects of temperature on growth of pollen tubes and resulting fertilization (Hormaza & Herrero 1996, Hedhly et al. 2004). This suggests there is natural trait variation that can be affected by rising global temperatures.</p>
G. Translocation risks	<p>There are no reciprocal common garden studies or provenance trials reported for <i>P. ilicifolia</i>.</p> <p>European researches have examined the risk gene flow of plants from tree plantations of distantly foreign genotypes into wild populations of <i>Prunus avium</i>, a clonal species with self-incompatibility. Over half the seed of maternal plants was sired by trees that existed within 100 m, with a maximum transfer of 696 m (Cottrell et al 2009). However, the fitness risks were not identified. The potential for such long dispersal distances needs to be considered if hybridization results in a drop in fitness.</p>

IX. SEEDS	<p>Seed and fruit image by John Macdonald (RSA Seeds 2016).</p> <div style="text-align: center;">  </div>
A. General	<p>The fleshy wall of the drupe is very thin and seeds are nearly as large as the fruits. Seeds are 11-25 mm, ovoid to spheroid, and smooth (Wall & McDonald 2009). Fruits and seeds are usually narrower in one direction (broadly oval in cross-section).</p>
B. Seed longevity	<p>In nature, seeds are expected to be short-lived (McMurray 1990). Seeds can be stored for at least two years. Approximately 75% of depulped seeds germinated after being stored at 10°C for two years (Borchert & Tyler 2010). See IX. G. Seed Storage for potential methods to increase longevity in storage.</p>
C. Seed dormancy	<p>Many <i>Prunus</i> species have embryo dormancy. The dormancy can be overcome with a period of after-ripening with moisture and oxygen (Grisez et al. 2008). A period of cold-moist stratification has resulted in germination for most species, including <i>P. ilicifolia</i>. Seeds that have been air-dried at ambient temperatures for storage may require a longer, moist period for after-ripening before about 3 mo of cold stratification or fall sowing (Grisez et al. 2008). In seven species, warm-moist stratification followed by cold-moist stratification improved germination.</p>
D. Seed maturation	<p>In southern California, fruits tend to ripen in summer with many fully ripe by mid-August (A. Montalvo pers. obs.). Mirov & Kraebal (1939) reported September to October as the seed collecting-season.</p>
E. Seed collecting and harvesting	<p>Collect fully mature fruits by hand stripping into open containers or sacks. Transfer to sealed plastic bags/containers for transport. Keep fruits away from heat and prevent desiccation; both heat and desiccation reduce seed viability (Borchert & Tyler 2010). When desiccated, seeds rattle when shaken; the louder the rattle, the higher the desiccation and lower the viability (Borchert & Tyler 2010). Process (wash) fruits soon after collecting to remove debris and potential contaminants. Clean fruits can be placed in sealed containers in a cold room until further processing to prevent fermentation.</p>
F. Seed processing	<p>Soak fresh fruits for about 1 hour and discard fruits that float because most floaters will be either hollow or parasitized (Wall & McDonald 2009). To remove fleshy pulp, rub with wooden block or place in blender, macerator, or hammermill with water, depending on batch size. Remove debris and macerated flesh by rinsing seeds over a screen. If fruits are air dried before removing pulp, they will need to soak several hours to soften the thin pulp. Seed filling and viability of harvested fruits is often high in <i>Prunus</i> (Grisez et al. 2008), but floating off empty seeds increases germination percentages of cleaned seed lots collected from the wild where seed parasitization can sometimes be high. Avoid fermentation of fruits when soaking because the process can reduce seed viability (Grisez et al. 2008). Air dry seeds for cold storage or process wet seeds for germination (see IX. H. Seed germination, and J. Planting).</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="349 1627 776 1926">  </div> <div data-bbox="795 1751 1079 1841" style="border: 1px solid black; padding: 5px;"> <p>Culling parasitized seeds before stratification.</p> </div> <div data-bbox="1124 1627 1601 1926">  </div> </div>
G. Seed storage	<p>More work is needed to determine how best to store seeds of <i>P. ilicifolia</i> to extend seed life. Drying seeds too much reduces viability substantially (Borchert & Tyler 2010). In general, seeds of <i>Prunus</i> need to be only surface dried and stored in sealed containers to control seed moisture. Some species can be dried to a moisture content of 11% and stored at 1 °C for 4.5 years with about a 10% drop in viability, and pin cherry can be stored in sealed containers at 1 to 3 °C for 10 years (Grisez et al. 2008).</p>

<p>H. Seed germination</p>  <p>Seedling . Inch scale. Photo: J. Dvorak, RCRC</p>	<p>Removal of pulp can increase germination success, and germination of stored seeds is likely to benefit from a period of warm, moist stratification followed by cold, moist stratification (Grisez et al. 2008). Plant in fall for natural stratification, or stratify 3 mo. and plant in March (see IX. C. Seed dormancy).</p> <p>Protocol from NPNPP (Young 2001): Soak cleaned seeds overnight and rinse in water; rinse in 5% bleach one minute, then rinse thoroughly with water. Place seeds in plastic freezer bag with equal amount of moist perlite and stratify at 40 °F (4.44 °C) for 1 to 3 months or until seeds begin to germinate. This treatment on a sample provided for 25% germination. Higher germination rates have been achieved by others (e.g., Borchert & Tyler 2010).</p> <p>In Riverside California, 96% of seeds germinated with the following treatment for fruits collected September 9th from the foothills of the Santa Ana Mountains within ecological region M262Bf (A. Montalvo & J. Dvorak unpublished data). Fruits were washed in water (floating fruits removed) and left to air dry inside for 21 days at about 76°F at which time fruits were soaked about two hours then processed to remove pulp (washed in water and screened to remove debris; no bleach); 330 sound seeds (sunk in water) were then placed in freezer bags with moist perlite and on day 22 placed in a walk-in cold room (temperature range: 42–46 °F). Another 13 seeds floated and were processed separately. Twenty-nine percent of the 330 seeds germinated by November 9th (by 4th week in coldroom), 45% by November 17th (by 6th week), and 77.6% by December 16th (by 9th week), and 86.7% by January 10 (by 13th week). By the end of the trial, 96% of seeds germinated (not checked until April). Of 96 germinated seeds transferred to quart pots, 94.8% emerged and produced healthy seedlings. For the 13 seeds that floated off after air drying, 4 did not germinate.</p>
<p>I. Seeds/lb</p>	<p>Weight of cleaned seeds (endocarps) averaged 1.46 g/seed (n = 143 seeds), or about 310 seeds/lb (Bullock 1981). Dryness of seeds was not stated. Mirov & Kraebal (1939) reported 200 seeds/lb. Weight of cleaned seeds: averaged 100 seeds/lb (range 91–109, n = 2 sample lots), but seed weight in <i>Prunus</i> changes as seeds dry, so seed weight averages can be extremely variable (Grisez et al. 2008).</p>
<p>J. Planting</p>	<p>In general, seeds of <i>Prunus</i> can be planted untreated in fall for natural vernalization or stratified and planted in spring (Grisez et al. 2008). Fresh hollyleaf cherry seeds can be planted in flats in October and emerge in about two months without stratification (Everett 2012), or stratified seeds planted in March about 1.5 cm deep (1 x the width of seed), one per pot, in 2" x 10 " tubes (Deepot 40) or larger pots with a well drained growing mix (Young 2001, see X. C. Horticulture.). If seeds have germinated in the stratification matrix, plant with root down, taking care not to break root, and cover seed with about 1.5 cm of soil (A. Montalvo & J. Dvorak pers. obs.). The tap root grows quickly before it branches, so deep pots provide for quality roots. Planted seeds need to be protected from foraging rodents and scrub jays.</p>
<p>K. Seed increase activities or potential</p>	<p>Harvesting from wild populations can be challenging in southern California except after a series of good rainfall years. Growing appropriately sourced and diverse material in strips such as within hedgerows could be a beneficial, cost effective way to produce genetically diverse seeds for habitat restoration.</p>
<p>X. USES</p>	
<p>A. Revegetation and erosion control</p>	<p>Used for controlling erosion on steep hillsides (McMurray 1990). Recommended for erosion control on dry slopes and roadsides for the following regions of California: Northwestern, Central Western, and Southwestern (Newton & Claassen 2003), but care must be taken to select sites with good drainage and appropriate exposures when planted in the drier, inland ecological subregions of the state. Successful plantings have been made by Caltrans in western Riverside Co. and elsewhere with minimal irrigation (A. Montalvo pers. obs.).</p>
<p>B. Habitat restoration</p>	<p>Recommended for habitat restoration in chaparral sites within canyons and valley bottoms, northerly-facing slopes, and along the top of stream banks in areas that are also appropriate for species that are commonly associated (see IV. A. Vegetation alliances, associations and B. Habitat affinity).</p> <p>Can be installed as containers or by direct seeding. Seeds can be planted similarly to acorns. Planting seeds under nurse plants is expected to be more successful than in full sun (e.g., Bullock 1981). If precipitation is insufficient, occasional watering increases success. Both container plants and seedlings can withstand infrequent, dry season irrigation during establishment. On Catalina Island, seedlings emerging from hand-planted seeds of Catalina cherry (at 2 per square meter) had higher survival in plots watered once a month in summer (60% survival) compared to unirrigated plots (24% survival) (Stratton 2004).</p> <p>Deep pots (18" deep) are preferred over regular one gallon pots for restoration plantings to accommodate the quickly developing tap root, and plants should be outplanted in fall to early winter (Meyer & Sale 2014). Plants need to be watered in and benefit from watering at least every other week until established in the absence of precipitation.</p>

<p>C. Horticulture or agriculture</p>  <p>Plant after 5 months in 4" x 9.5" deep pot. A. Montalvo.</p>	<p>Hollyleaf cherry has been widely cultivated in gardens for many years (McMinn 1939, Bornstein et al. 2005, Perry 2010). It is adaptable and can be left to its natural form, pruned, hedged, or shaped into a small tree. Plants combine well with other species such as <i>Heteromeles arbutifolia</i> and <i>Rhus ovata</i> into background screens. In research with containerized plants at high evapotranspiration sites of Davis and Riverside, California, <i>P. ilicifolia</i> was found to be one of the lowest water users of the evergreen woody shrubs tested (Schuch & Burger 1998). In addition, hollyleaf cherry with its sclerophyllous, evergreen leaves is considered to be among the native plants less quick to ignite, and plants are often planted in landscaping in high fire danger zones (e.g., Montgomery & Cheo 1971). Furthermore, the plants are seldom bothered by pests (exception is white fly) and they tolerate soils infected with the oak root fungus <i>Armillaria mellea</i> (Bornstein et al. 2005, Everett 2012). Occasionally some shoots may be affected by fire-blight, which should be cut out and disposed of or burned to limit spread.</p> <p>Deep pots are preferred for hollyleaf cherry over regular one gallon pots for restoration plantings to accommodate the quickly developing tap root. Plants should be outplanted in late fall to early winter (Meyer & Sale 2014). As container plants, most <i>Prunus</i> are outplanted after 1 to 2 years of growth (Grisez et al. 2008). In the RCRCN nursery in Riverside (A. Montalvo pers. obs.), seedlings of hollyleaf cherry that emerged in March and April and planted in pots inoculated with a half tsp. of whole soil, and without pushing growth with fertilizers, were ready for outplanting by October (within 9 months). If grown in D-40 tubes, plants that emerge in March and April should be shifted to 4" x 18" deep tree pots by September then outplanted in early winter or held until the next year and planted out in the fall. Seedlings planted in March-April directly into 3 to 4 inch wide and 10 inch deep pots can hold for fall planting.</p>
<p>D. Wildlife value</p>	<p>Fruits are a food source for many bird species and mammals. Coyotes (Bullock 1981, Silverstein 2005), black bears, grey fox and other mammals (Borchert & Tyler 2010, see VI. F. Seed dispersal) consume the ripe fruits. In urban gardens and elsewhere, scrub jays, mockingbirds, and American robins collect the fruits (Bornstein et al. 2005).</p> <p>In the San Gabriel Mountains, the leaves are browsed by mountain sheep (<i>Ovis canadensis nelsoni</i>) in all seasons, but primarily in fall (Perry et al. 1987), and mature leaves are browsed by California mule deer (<i>Odocoileus hemionus</i>) (Borchert et al. 2004).</p>
<p>E. Plant material releases by NRCS and cooperators</p>	<p>None.</p>
<p>F. Ethnobotanical</p>	<p>The pulp of the fruits were sometimes eaten, but the kernel of the seeds were eaten by native tribes throughout the range of <i>P. ilicifolia</i>, and a variety methods were used to process the seeds to leach out toxic compounds, likely amygdalin that releases cyanide (Timbrook 2007, Garcia & Adams 2009). The seeds should only be eaten if processed correctly to prevent cyanide toxicity (Immel 2003, Garcia & Adams 2009). For example, the Costanoans beat the fruits to remove the pulp, shelled the seeds, soaked the released kernel in warm water, then roasted them before consuming (Bocek 1984). The fruits were an important source of food for the Cahuilla in late summer (Bean & Saubel 1972). They crushed the kernels, leached them, then boiled them into an atole.</p> <p>A tea was also sometimes made from the bark to treat colds, steam from boiling leaves breathed to relieve flu, and a wash from the leaves applied for headaches (Garcia & Adams 2009). Garcia & Adams recommend avoiding the internal remedies, including breathing steam, because of the danger of cyanide toxicity.</p>
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<p>XII. CITATION</p>	<p>Montalvo, A. M., E. C. Riordan, and J. L. Beyers. 2018. Plant Profile for <i>Prunus ilicifolia</i>. Native Plant Recommendations for Southern California Ecoregions. Riverside-Corona Resource Conservation District and U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Riverside, CA. Online: https://www.rcrcd.org/plant-profiles</p>
<p>XIII. LINKS TO REVIEWED DATABASES & PLANT PROFILES</p>	
<p>Fire Effects and Information System (FEIS)</p>	<p>https://www.fs.fed.us/database/feis/plants/shrub/pruili/all.html</p>
<p>Calflora</p>	<p>https://www.calflora.org/</p>
<p>Calscape</p>	<p>https://calscape.org/Prunus-ilicifolia-ssp.-ilicifolia-(Hollyleaf-Cherry)?srchcr=sc5bca7745e3284</p>
<p>Jepson Interchange</p>	<p>https://ucjeps.berkeley.edu/interchange/</p>
<p>Jepson eFlora (JepsonOnline, 2nd ed.)</p>	<p>https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=39987</p>
<p>USDA PLANTS</p>	<p>https://plants.usda.gov/core/profile?symbol=PRIL</p>

Native Plant Network Propagation Protocol Database (NPNPP)	https://npn.rngr.net/propagation/protocols
Native Seed Network (NSN)	https://nativeseednetwork.org/
Native Plant Notebook (NPN)	https://www.fs.usda.gov/detailfull/umatilla/learning/nature-science/?cid=stelprdb5251304&width=full
GRIN (provides links to many recources)	https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearch.aspx
Flora of North America (FNA) (online version)	http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250100394
Flora of North America (FNA) (families covered)	http://floranorthamerica.org/families
Native American Ethnobotany (NAE)	naeb.brit.org/uses/search/?string=prunus+ilicifolia
Woody Plant Seed Manual search for taxon in file	https://www.fs.usda.gov/treesearch/pubs/32626
Rancho Santa Ana Botanic Garden Seed Program, seed photos	http://www.hazmac.biz/050228a/050228aPrunusIlicifolia.html
XIV. IMAGES	<p>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.</p> <p>Photo in cell X. H. by John Dvorak, RCRC. All other photos 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.</p>

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