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The Morton Arboretum



San Diego Zoo
Wildlife Alliance



Oaks of the Californias' Conservation Action Plan

This plan followed the IUCN CPSG Principles and Steps.

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Figure 1. From right to left: *Quercus cedrosensis* in habitat. Photo: Tony Gurnoe, *Quercus dumosa* in habitat. Photo: Stacy Anderson, *Quercus engelmannii* Photo: James Henrich, *Quercus pacifica*, © 2010 CalScape. Photo taken at California Botanic Garden, *Quercus parvula* var. *shrevei* © 2020 R.A. Chasey, *Quercus tomentella* in habitat. Photo: Vince Scheidt

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Plan Development Background

Importance of Oaks

Comprising around 450 species, oaks are found in forest and shrubland ecosystems throughout the northern hemisphere. As keystone species, they exhibit an astonishing array of morphological and ecological diversity, thriving in the subtropical forests of southeast Asia, the deserts of Mexico, and the temperate hardwood forests of North America. Their two centers of diversity are in Mexico and eastern Asia, both of which harbor nearly 200 native species.

Oaks are prized for their sturdy timber and are valuable sources of wood for building ships, wine barrels, and fine furniture. They are the source of many other non-timber products such as cork, tannins and nutritious acorns for feeding livestock. These iconic trees grace the flags of many nations and states and hold cultural and religious value for people around the world.

Despite their great economic, ecological, and cultural value, many oaks are under threat of extinction. The Red List of Oaks (Carrero et al., 2020) reveals that at least one-third of the world's oak species are at risk of extinction. Species identified as at risk of extinction require conservation action to ensure that they not only survive but are also resilient to the myriad threats they face. This entails protection of threatened wild populations of plants in their natural habitats, and *ex situ* conservation in botanic gardens and seed banks. Because oaks are “exceptional species” – their acorns do not survive the low temperature and humidity conditions of a standard seed bank – these species require alternative methods for effective *ex situ* conservation of genetic diversity. Living collections of trees and cryopreservation of embryos and vegetative (growth) tissues are two solutions to this challenge, but these require more time, expertise, and management than standard seed banking. Thus, oaks are in urgent need of a coordinated, global effort to efficiently and effectively preserve species and populations both in their native habitats and in *ex situ* collections.

Given the large, global distribution of oaks and the myriad of threats they face, the Global Conservation Consortium for Oak (GCCO), which falls under Botanic Gardens Conservation International (BGCI) was launched to coordinate a network of institutions and experts to collaboratively implement comprehensive conservation strategies to prevent extinction of the world's oak species. The GCCO is led by The Morton Arboretum and has successfully established the network in the US, Mexico and Central America, China and Southeast Asia. In the US specifically, the GCCO is focusing on conservation efforts for 29 priority threatened species, as a result of the Conservation Gap Analysis of Native US Oaks (Beckman et al., 2019). The US region for the GCCO is divided into three sub-regions, based on where the species are distributed geographically. There is the Eastern US, Texas Southwest and the Western US sub-regions, all of which focus on 10, nine, and 10 priority species, respectively.

Plan development process

Since the GCCO launched in the Western US sub-region (2020) (which focuses on the following priority species: *Quercus cedrosensis*, *Q. cornelius-mulleri*, *Q. dumosa*, *Q. lobata*, *Q. engelmannii*, *Q. pacifica*, *Q. palmeri*, *Q. parvula*, *Q. sadleriana*, and *Q. tomentella*), one of the

GCCO Affiliates, Christy Powell (San Diego Zoo Wildlife Alliance) decided to start the Channel Island Native Oak working group. This working group focuses its discussions around the Channel Island oak species: *Quercus cedrosensis*, *Q. dumosa*, *Q. engelmannii*, *Q. pacifica*, *Q. parvula* and *Q. tomentella*, and are now meeting on a quarterly basis. Throughout these meetings, we identified overlap in conservation projects, and new collaborations were forming, so we decided it would be an ideal next step to develop a species management plan for these priority threatened oaks, following the IUCN CPSG Principles and Steps. This plan would expand upon the conversations held during the working group meetings and begin to identify gaps in the conservation of these species and help us to prioritize which actions to focus on moving forward. Also, a lot of baseline information has already been gathered through the development of the Conservation Gap Analysis of Native US Oaks (Beckman et al., 2019) as well as The Red List of Oaks 2020 (Carrero et al., 2020), which we could use as a starting point for identifying priority, conservation actions. Therefore, given this background information, guiding documents, and collaborative coordination through the GCCO network and the Channel Island Native Oak working group, we had the opportunity to discuss in more detail the conservation gaps, challenges, and next steps to take to actively conserve these threatened oak species. Finally, we had the opportunity to begin to draft a plan during the upcoming, Channel Island and California Native Oak in-person workshops, which were funded by an Association of Zoological Horticulture and DCF grant to the San Diego Zoo Wildlife Alliance.

Plan overview and implementation framework

This is a living document and was developed in December 2021 as a result of the California and Channel Islands Native Oak Workshop. This plan is following a 10 year timeline but will be reviewed annually through communication via email and meetings, and another workshop will be held at the five-year mark. Additional information can be added at any time, given it is reviewed and accepted by all who were a part of the workshops and/or a listed collaborator in this plan. Plans will be published on the Global Conservation Consortia website (including in draft format). Accompanying this larger management plan are smaller, species-specific action tables, which can be found at the bottom of this document, that highlight the specific actions that will be taken to mitigate species specific threats and contribute to the overall conservation of the species. They are also following a 10 year timeline and will be updated quarterly, with the support of identified working group leads who will manage and track progress made.

This plan covers the entire range of the oaks of the Californias including: *Q. cedrosensis*, *Q. dumosa*, *Q. engelmannii*, *Q. pacifica*, *Q. parvula*, *Q. tomentella* and was developed in collaboration with stakeholders from a variety of sectors. This plan and the species-specific action tables are open to feedback from other collaborators who were not involved in the management plan workshops.

The implementation of this plan will be overseen by the Species Coordinator, [Christy Powell](#), San Diego Zoo Wildlife Alliance with support from the Global Conservation Consortium for Oak (GCCO) Coordinator, [Amy Byrne](#), The Morton Arboretum, the identified species-specific working group leads, and BGCI's Global Conservation Consortia Manager, [Dan Crowley](#).

Each action table will have identified responsible stakeholders and collaborators, and ultimately, a formed working group, who will meet and communicate on a quarterly basis to ensure the activities are executed over the given timeframe. If you have any questions or feedback, please contact those who will oversee the implementation of each plan.

Acronyms

- BGCI - Botanic Gardens Conservation International
- CNPS - California Native Plant Society
- CPSG - Conservation Planning Specialist Group
- GCCO - Global Conservation Consortium for Oak
- IUCN - International Union for the Conservation of Nature
- SDZWA - San Diego Zoo Wildlife Alliance
- USFS - US Forest Service

Defining Success

Vision Statement

What we see as success for the species and the implementation of this action plan:

1. Through the collaborative efforts of conservationists, researchers, educators, policy makers, land managers, and indigenous communities, we will ensure the sustainability and diversity of the oaks of the Californias' ecosystems, creating a future where humans and oaks can thrive in harmony; recognizing and supporting the ecological and cultural values oaks hold.

Our strategies to achieve success:

Through the implementation of this action plan, we will achieve success once we have met the goals (in bold), aligning with our indicators of success (outlined below). Our high-level plan to achieve these goals is as follows:*

1. **To better understand the relationships within and between these taxa we will implement activities under the following strategies:**
 - a. Identify locations of plants and species (gap analysis) including *ex situ* accessions
 - b. Assess how climate change will impact the wild populations
 - c. Gather more information on propagation techniques, habitat, climate preferences and soil type preferences
 - d. Recruit new stakeholders
 - e. Morphological/morphometric studies and genetic analysis
2. **Gather more information to better understand the mechanisms that prohibit the regeneration and persistence of oaks, so we can intervene and mitigate these negative impacts so as to prevent further loss of individual oaks; strategies include:**
 - a. Survey species populations to identify and record all the co-occurring invasive and noxious species
 - b. Conduct observational studies: monitor the populations over a set period of timed intervals (e.g. bi-annual surveys)

- c. Develop a management plan to remove or mitigate the impact of invasive/noxious species
- 3. Coordinate collaborative, cross-sector collecting/surveying trips to ensure that the species' full range and genetic breadth is captured across living collections so that the species is well-conserved into the future, can be utilized for research and there is ample germplasm for future restoration efforts; strategies include:**
 - a. Conduct annual or bi-annual monitoring and collecting trips for each species to ensure populations are tracked, and germplasm is collected from each to improve genetic diversity capture in living and cryopreservation collections
 - b. Implement and/or utilize a currently established mechanism to document and identify where extra germplasm can be shared to other institutions so that individuals are well-represented across several collections
 - c. Conduct population genetic studies to compare the level of genetic diversity captured in collections vs the current wild genetic diversity so to better improve future collection efforts and fill in the collection gaps
 - d. Document propagation protocols (propagating plants from seed, scions/grafts or tissue culture) and distribute to a larger audience so as to improve the growth and survival of these species
- 4. Initiate education and outreach activities to inform a diverse group of stakeholders, stay abreast to current research and knowledge gaps, and be able to package the information into easily digestible formats; strategies include:**
 - a. Gain a better understanding of what different audiences do not know about these species, and how they receive their news/information either through surveys or discussion forums, so to create more targeted resources/opportunities that build more support around the conservation of these species
 - b. Create opportunities for public engagement, geared toward priority audiences, including webinars, workshops and conferences
 - c. Share resources/tools via social media and other outlets to engage more stakeholders in our conservation efforts (e.g. sharing links to iNaturalist projects to increase surveying participation)
 - d. Amplify or expand upon any opportunity that information on these oak species can be shared (e.g. in magazine articles, on one's institution website or newsletter, etc.)
- 5. Review current threat and protection statuses for each species to prioritize which species status needs to be elevated, and better understand each listing process, so that each species can receive the proper monitoring and protection into the future; strategies include:**
 - a. Conduct literature reviews and compile information to know what statuses are currently listed for each species, and evaluate the benefits of each listing so to prioritize which statuses need to change/be upgraded
 - b. Learn more about each listing process to understand which information needs to be gathered to move forward with identified status listings
 - c. Create a model workflow on the listing process for each threat/protection status so that this can be replicated for future listings for additional priority oak species in the future

*For more information on the specific activities we plan to conduct for each multi-species focused goal, outlining the time frame and other details, please see the action statement tables below starting on page 15.

Species Background

Species Overview

Species names and descriptions

Species name: *Quercus cedrosensis* C.H.Mull.

Synonyms: *Quercus sedrosensis* C.H.Mull.

Common names: Cedros Island Oak

Section: Protobalanus (Intermediate or Golden Oak)

IUCN Red List: Vulnerable

California Rare Plant Rank: 2B.2

Global/State Rank: G3,S1; Not Federally or State listed

Bloom period: April- May

Elevation: 835-3150 feet

Fruiting: Every 2 years

Soil: Metamorphic rock land

Habitat: Chaparral

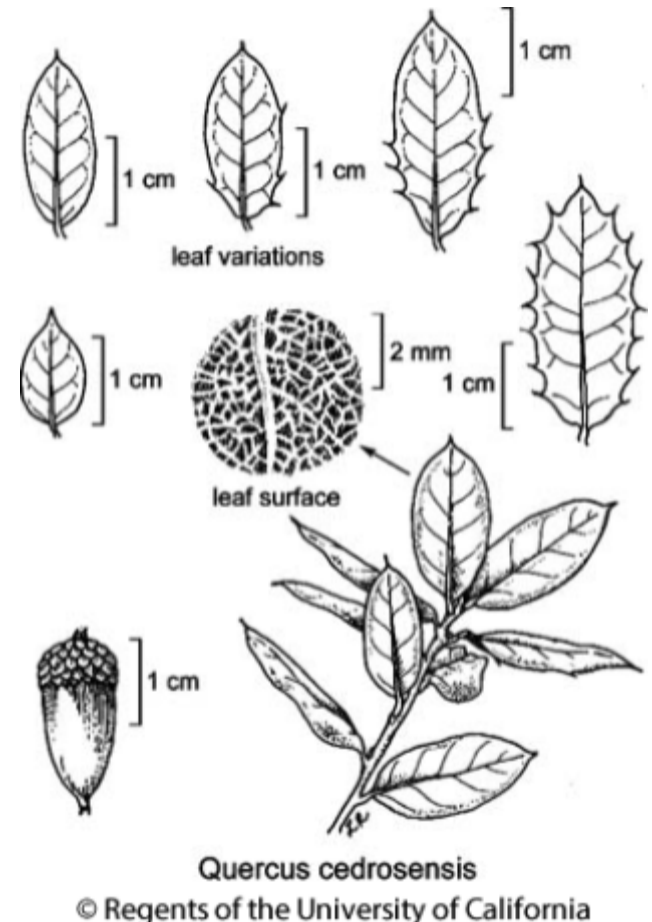
Distribution: This *Quercus* occurs in Baja California (Mexico), where it is concentrated in the northern half, and on Cedros Island located off the west coast of the peninsula. One unverified occurrence is located further south, across the border into Baja California Sur, Mexico. Recent discoveries have also been documented with a small population near the Otay Mountains (California, USA) just north of the border with Mexico. Occurrences in southern California and Baja California include low elevation sites from 75–1,000 m, sometimes up to 1,400 m. Species' occurrences on Cedros Islands however, include higher elevations, beginning at 1,000 m (Muller 1965, le Hardy de Beaulieu and Lamant 2010).

Ex situ collections: 3 listed institutions on PlantSearch

Herbarium samples: 8 at the Natural History Museum in San Diego

Identification: From Jepson eFlora: Taxon page https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=80204

Tree to 5 m, decumbent shrub 2--3 m, or prostrate shrub to 2 dm, evergreen; trunk bark flaky, gray; twigs brown, hairy, dark gray in age; buds 1 mm, widely ovoid or subround, light brown, sparsely hairy. Leaf: 0.6--2(3.5) cm; petiole 1.5--2.5 mm; blade lanceolate, ovate, oblong, elliptic, or subround, adaxially flat or convex, glossy green, glabrous, abaxially glaucous, glabrous, veins white, base rounded or



cordate, tip acute to widely rounded, generally spine-like, margin entire or with few irregular spine-tipped teeth. Fruit: stalk +- 0--10 mm; cup 7--12 mm wide, 5--6 mm deep, cup-shaped, scales thickened basally; nut 15--22 mm, narrowly ovoid to fusiform, distally acute to +- obtuse, shell tomentose inside; mature in year 2.

Species name: *Quercus dumosa* Nutt.

Synonyms: Originally the species name applied to almost all of these shrubs, including *Q. berberidifolia*, *Q. durata*, *Q. john-tuckeri*, *Q. cornelius-mulleri*, *Q. pacifica* (all recognized taxa within the complex today), *Q. macdonaldii*, and *Q. turbinella*. *Quercus berberidifolia* was the last remaining species frequently labeled *Q. dumosa*, and therefore represents the majority of misidentified herbarium specimens today. Here is a list on all synonyms on Kew's Plants of the World Online

Quercus dumosa f. *crispata* Trel.

Quercus dumosa f. *diversifolia* Trel.

Quercus dumosa var. *elegantula* (Greene) Jeps.

Quercus dumosa subsp. *eudumosa* A.Camus

Quercus dumosa f. *insularis* Trel.

Quercus dumosa f. *linearis* Trel.

Quercus dumosa var. *linearis* (Trel.) A.Camus

Quercus dumosa f. *longigemma* Trel.

Quercus dumosa f. *microcarpa* Trel.

Quercus dumosa f. *myrtifolia* Trel.

Quercus dumosa f. *populifolia* Trel.

Quercus dumosa var. *populifolia* (Trel.) A.Camus

Quercus × *macdonaldii* var. *elegantula* Greene

Common names: Nuttall's scrub oak

Section: *Quercus* (White Oak) **Group:** California scrub white oaks

IUCN Red List: Endangered

California Rare Plant Rank: 1B.1

Global/State Rank: G3,S3; Not Federally or State listed

Bloom period: March-May

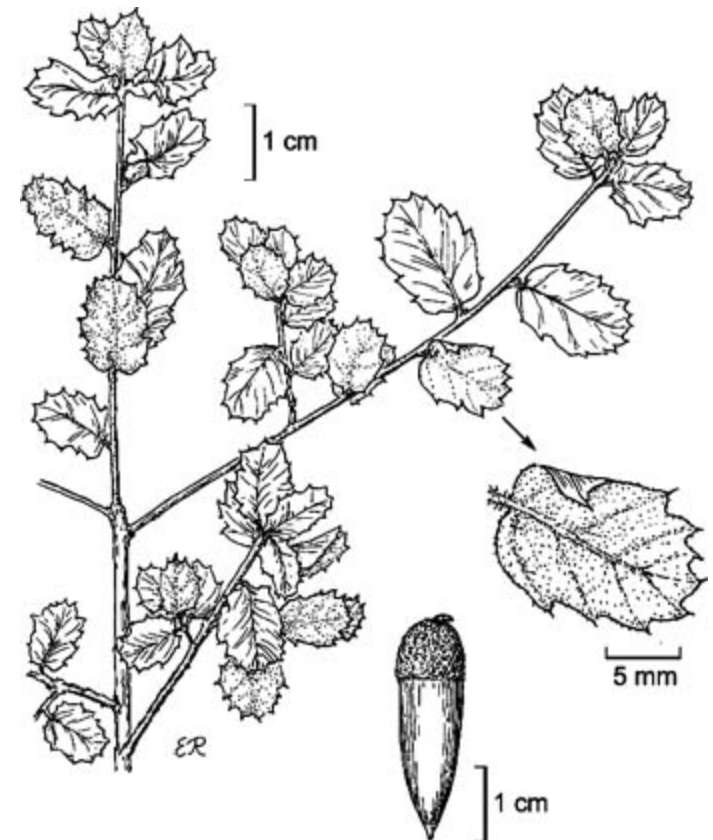
Elevation: less than 700 ft

Fruiting: Every year

Soil: Chesterton-Urban land complex

Habitat: Generally sandy soils near coast, sandstone, chaparral, coastal-sage scrub

Distribution: The species occurs within Orange, Santa Barbara and San Diego Counties of southern California, extending slightly into Baja California, Mexico (NatureServe 2013).



Quercus dumosa

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Ex situ collections: 23 listed institutions on PlantSearch

Herbarium samples: 7 at Kew, 78 at the Natural History Museum in San Diego

Identification:

From Jepson eFlora: Taxon page https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=40582

Shrub 1--4 m, generally evergreen; twigs slender, 1--1.5 mm diam, sparsely short-hairy, dark red-brown, glabrous in age. Leaf: 1--2.5 cm; petiole < 5 mm; blade oblong, elliptic, or +- round, adaxially +- convex or not, +- shiny, green, abaxially fine-tomentose, in age glabrous, dull, pale green, tip obtuse to abruptly pointed, margin +- wavy or not, +- spine-toothed. Fruit: cup 8--15 mm wide, 5--8 mm deep, generally bowl-shaped, scales +- tubercled; nut 10--20 mm, +- slender, generally ovoid, distally acute to obtuse, shell glabrous inside; mature in year 1.

Species name: *Quercus engelmannii* Greene

Synonyms:

Common names: Engelmann oak

Section: *Quercus* (White Oak) **Group:** Glaucoideae

IUCN Red List: Endangered

California Rare Plant Rank: 4.2

Global/State Rank: G3,S3

Not Federally or State listed

Bloom period: March-June

Elevation: less than 4,300ft

Fruiting: Every year

Soil: Wyman loam

Habitat: Slopes, foothills, woodland

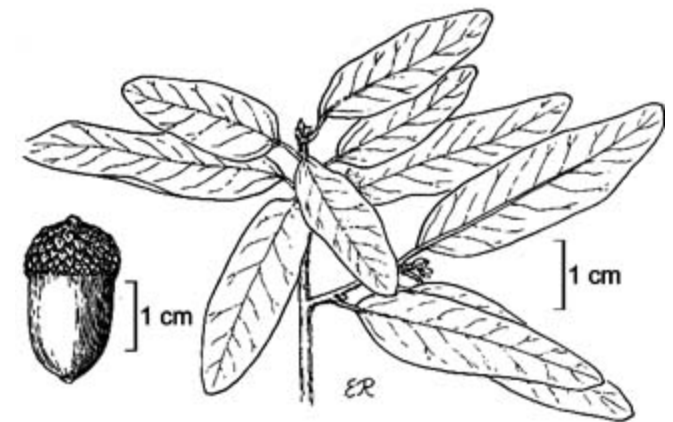
Distribution: *Quercus engelmannii* is native to southern California and northwestern Baja California, Mexico. It occurs in four of California's Floristic Provinces: South Coast, San Gabriel Mountains, Peninsular Ranges, and San Jacinto Mountains (The Jepson Herbarium).

Ex situ collections: 22 listed institutions on PlantSearch

Herbarium samples: 155 at the Natural History Museum in San Diego

Identification: From Jepson eFlora: Taxon page https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=40590

Tree 5--25 m, evergreen; trunk bark narrowly furrowed, scaly, +- gray; young twigs finely tomentose, in age glabrous. Leaf: 2--6 cm; petiole 3--7 mm; blade oblong to obovate, adaxially dull blue-green, abaxially soft-hairy, glabrous in age, pale blue-green, tip obtuse to rounded, margin generally entire to wavy-dentate. Fruit: cup 10--15 mm wide, 6--8 mm deep, cup- to bowl-shaped, scales +- tubercled; nut 15--25 mm, oblong-cylindric to ovoid, distally obtuse to rounded, shell glabrous inside; mature in year 1. native range is S. California to Mexico (N. Baja California)



Quercus engelmannii

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Species name: *Quercus pacifica* Nixon & C.H.Müll.

Synonyms: Old records lump with *Quercus dumosa*

Common names: island scrub oak

Section: Quercus (White Oak) **Group:** California scrub white oaks

IUCN Red List: Endangered

California Rare Plant Rank: 4.2

Global/State Rank: G4,S4

Not Federally or State listed

Bloom period: March-Apr

Elevation: 0-1410 feet

Fruiting: Every 2 years

Soil: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA688/0/CA688.pdf

Habitat: Slopes, ridges, canyons, chaparral, coastal scrub, oak woodland, pine forest

Distribution: *Quercus pacifica* is endemic to three of the California Channel Islands: Santa Cruz, Catalina, and Santa Rosa. It is not present on the California mainland, but did previously bear the name *Quercus dumosa*, as was applied to a few shrub oaks in the "Q. dumosa complex." Within this complex existed at least five species now recognized as distinct taxa, based on acorn morphology, leaf vestiture, and habitat (Banks 2014). This species occurs from 0-300 m asl (FNA 1997), and has an estimated extent of occurrence of 3,800 km² (IUCN Red List).

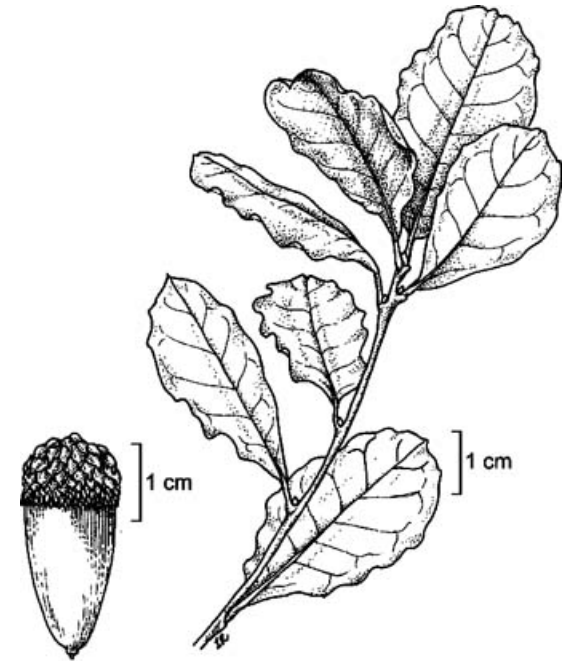
Ex situ collections: 14 listed institutions on PlantSearch

Herbarium samples: None at the Natural History Museum in San Diego

Identification:

From Jepson eFlora: Taxon page https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=80203

Habit: Shrub to 2 m (small tree to 5 m), generally evergreen; twigs finely hairy, +- red or +- brown, glabrous in age, gray. Leaf: 1.5--4 cm; petiole 2--5 mm; blade obovate or oblong, adaxially green, abaxially light green with minute appressed stellate hairs, in age glabrous, base gradually tapered, wedge-shaped, or rounded, tip generally rounded, margin entire, wavy, or +- toothed, teeth generally mucronate. Fruit: cup 8--20 mm wide, 5--15 mm deep, hemispheric to top-shaped, scales moderately to strongly tubercled; nut 20--30 mm, ovoid to cylindrical, distally acute to +- obtuse, shell glabrous inside; mature in year 1.



Quercus pacifica

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Species name: *Quercus parvula* Greene var. *shrevei* (C.H.Mull.) Nixon
Synonyms: *Quercus celata* Jeps. ined., Treated as a synonym of *Quercus wislizeni* by Jensen in FNANM 3:452 (1997)
Common names: shreve oak

Section: Lobatae (Red or Black Oaks) **Subgenus:** *Erythrobalanus*
IUCN Red List: not listed
California Rare Plant Rank: This taxon was Considered But Rejected on 2010-03-15
Global/State Rank: not ranked
 Not Federally or State listed
Bloom period: March - May
Elevation: <3,900 ft
Fruiting: Every 2 years
 Hybridizes with *Quercus agrifolia*, *Quercus kelloggii*

Soil:
https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA688/0/CA688.pdf
Habitat: Tree < 30 m, evergreen. Leaf: 3--9(14) cm; petiole 2--10(15) mm; blade oblong, lanceolate, or ovate to obovate, adaxially glabrous, olive-green to dark green, abaxially glabrous, generally +- dull, light olive-green, tip obtuse to acute or acuminate, margin spine-toothed (or long-tapered-dentate) to generally entire. Fruit: cup 12--15 mm wide, 6--10 mm deep, generally bowl-shaped, scales +- thin, not tubercled; nut (15)30--45 mm, barrel-shaped to ovoid, distally obtuse to +- rounded, puberulent, shell wooly inside; mature in year 2. moist woodland, forest

Distribution: Of the California Floristic Province, this species occurs in Western Transverse Ranges, Outer South Coast ranges, San Francisco Bay Area, Central coast, Inner North Coast ranges and North Coast.

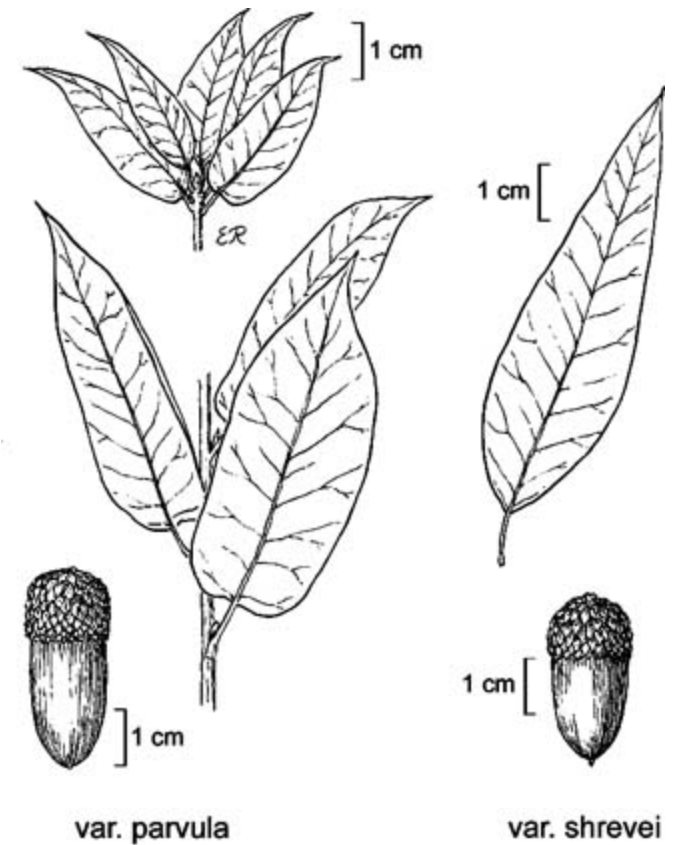
Ex situ collections: 9 listed institutions on PlantSearch

Herbarium samples: none at the Natural History Museum in San Diego

Identification:

From Jepson eFlora: https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=76907

Species name: *Quercus parvula* Greene var. *parvula*



Quercus parvula

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Synonyms:

Common names: Santa Cruz Island oak

Section: Lobatae (Red or Black Oaks) **Subgenus:** *Erythrobalnus*

IUCN Red List: Endangered

California Rare Plant Rank: 4.2

Global/State Rank: G4T3/S3

Not Federally or State listed

Bloom period: (Mar) Apri-Jun (CNPS)

Elevation: 100-3,000 ft

Fruiting: Every year

Hybridizes with *Quercus kelloggii*

Soil: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA688/0/CA688.pdf

Habitat: Shrub 1--2 m. evergreen. Leaf: 3--9(14) cm generally entire; petiole 2--10(15) mm; blade oblong, lanceolate, or ovate to obovate, adaxially glabrous, olive-green to dark green, abaxially glabrous, generally +- dull, light olive-green, tip obtuse to acute or acuminate, margin spine-toothed (or long-tapered-dentate) to generally entire. Fruit: cup 12--15 mm wide, 6--10 mm deep, generally bowl-shaped, scales +- thin, not tubercled; nut (15)30--45 mm, barrel-shaped to ovoid, distally obtuse to +- rounded, puberulent, shell woolly inside; mature in year 2. moist woodland, forestClosed-cone coniferous forest, maritime chaparral, cismontane woodland

Distribution: Two small subpopulations on Santa Cruz Island and 5--6 subpopulations in Santa Barbara County are known. No subpopulation extends over more than 10 km² (IUCN Red List)

Ex situ collections: 3 listed institutions on PlantSearch

Herbarium samples: none at the Natural History Museum in San Diego

Identification:

From Jepson eFlora: https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=76907

Habit: tree < 100ft

Species name: *Quercus tomentella* Engelm.

Synonyms: *Quercus chrysolepis* var. *tomentella* (Engelm.) A.E.Murray, *Quercus chrysolepis* subsp. *tomentella* (Engelm.) A.E.Murray, *Quercus tomentella* var. *conjungens* Trel., *Quercus tomentella* f. *conjungens* (Trel.) Trel.

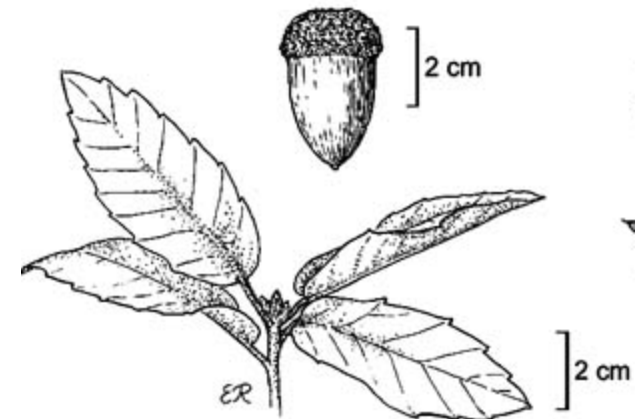
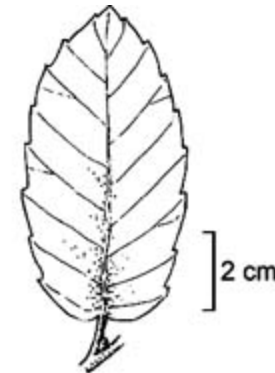
Common names: island oak

Section: Protobalanus (Intermediate or Golden Oaks)

IUCN Red List: Endangered

California Rare Plant Rank: 4.2

Global/State Rank: G3G4,S3S4



Quercus tomentella

Not Federally or State listed

Bloom period: March-July

Elevation: 50 - 2395 feet

Fruiting: Every 2 years

Soil: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA688/0/CA688.pdf

Habitat: closed-cone coniferous forest, chaparral, cismontane woodland, riparian woodland, canyons, slopes

Distribution: *Quercus tomentella* is found only on the Channel Islands (Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, and San Clemente) off the coast of California, and Guadalupe Island, Mexico. The species belongs to a small, mysterious group of oaks which only exists in the western United States and northern Baja California, Mexico: the intermediate or golden oaks, section *Protobalanus* (Ashley et al. 2007)

Ex situ collections: 22 listed institutions on PlantSearch

Herbarium samples: 1 at the Natural History Museum in San Diego (Pacific Beach, Kate O. Sessions)

Identification:

From Jepson eFlora: Taxon page https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=40764

Habit: Tree < 20 m, evergreen; trunk bark furrowed, scaly, gray or red-brown; young twigs tomentose. Leaf: 5--8 cm; petiole 5--18 mm; blade oblong to oblong-ovate, adaxially +- finely tomentose, glabrous in age, dark green, abaxially densely tomentose, sparsely tomentose in age, dull, gray-green, tip acute to obtuse, margin entire to crenate or mucro-toothed. Fruit: cup 20--30 mm wide, 6--8 mm deep, saucer- to bowl-shaped, scales thick, tubercled; nut 20--35 mm, widely ovoid, distally rounded, shell +- wooly inside; mature in year 2.

Eco-geographical information

You can view the species occurrence maps [here](#); the maps have triangle points overlaid the occurrence points to show which populations have been collected from and are now found in living collections.

Species Threats

As identified by the workshop participants. The threat maps can be accessed [here](#) for more detailed information.

Threats to *Quercus cedrosensis*:

- Baja California, MX: occur on private lands, not protected under Norma Oficial (Mexican protected species), agricultural impacts, historic logging, mining, construction, lack of knowledge on the native range
- Climate change: drought, increased fire risk, lack of marine layer influence
- *Ex situ* collections: low representation, permitting challenges, low acorn production in the wild
- Habitat: fragmented, small occurrences, invasive woody/herbaceous species, roads and construction, recreational use of trails leading to trampled seedlings, low ground water availability, low recruitment
- Taxonomy: taxonomic questions that need to be resolved to identify the species, potential hybridization challenges
- US/MX Border: road expansion, border wall construction

Threats to *Quercus dumosa*:

- Baja California, MX: permitting challenges, agricultural impacts
- Climate Change: high fire frequency in some areas, and lack of fire in areas
- Education/outreach: lack of understanding or awareness of the species leading to less protection
- Habitat: habitat loss, clear cutting, occur on private land, recreation such as mountain biking, hiking, horseback riding, foraging/collection, invasive woody/herbaceous species, pests and disease such as the Invasive shot hole borer
- Natural systems modification
- Taxonomy: misidentification, high hybridization, inaccurate surveying, lack of knowledge of the native range

Threats to *Quercus pacifica*:

- Climate change: pests and disease susceptibility, drought, increased ignition risks and fuel loads, fire frequency—fires are not occurring when needed in the environment
- Education/outreach: lack of understanding or awareness of the species leading to less protection
- *Ex situ* collections: low representation in living collections
- Habitat: lack of dispersal by the Island Scrub Jay (was the historical disperser for this species), low recruitment, invasive woody/herbaceous species, dams, road construction/maintenance, recreation such as camping, aquifer drawdown, limited biosecurity
- Non-native animals: trampling of seedlings and predation of acorns by vertebrates (e.g. deer and bison), soil erosion, lack of deer management
- Research: little knowledge on potential pests/pathogens, current state of dieback, native range, and how old *Q. pacifica* lives

Threats to *Quercus engelmannii*:

- Climate change: drought, increase in fire frequency
- Education and outreach: lack of understanding or awareness of the species leading to less protection
- *Ex situ* collections: low representation in living collections
- Habitat: agriculture, land clearing for agriculture and vineyards, water availability, firewood harvesting, grazing, low recruitment, predation of acorns, military activity
- Protection: lack of protection within populations
- Research: lack of acorn production information/mast cycle, rainfall patterns, and if hybrids can serve as seed sources for future plantings

Threats to *Quercus parvula*:

- Habitat: invasive woody/herbaceous, pests and diseases, occur on private land, fragmentation, fire, isolated populations, recreation, agriculture, animal grazing, road construction, residential and community development
- *Ex situ* collections: low representation in living collections
- Taxonomy: misidentification between subspecies and hybrids leading to lack of information on the full native range

Threats to *Quercus tomentella*:

- Climate change: drought, increase fire frequency, increase invasive species, hurricanes
- Education and outreach: lack of understanding or awareness of the species leading to less protection
- *Ex situ* collections: low representation in living collections, obtaining collecting permit challenges, low acorn production in the wild
- Habitat: grazing, soil erosion contributing to water availability, invasive woody/herbaceous species, predation of acorns/seedlings, lack of dispersal by the Island Scrub Jay (was the historical disperser for this species), current and future pests and diseases, hydrology– lack of fog, road construction/maintenance, lack of freshwater, low recruitment, lack of biosecurity, recreation such as trails, hiking, camping, wind erosion
- Research: lack of understanding the species genetic makeup, and understanding the different threats on each island such as acorn masting, and pests

Multi-Species Threats:

1. Knowledge Gap: misidentification of species, lack of accurate native range distribution maps
2. Invasive woody/herbaceous species, Non-native animals/grazing
3. *Ex situ* collections, low representation across species in collections, low acorn production in the wild
4. Development and natural systems modification, leading to habitat loss
5. Lack of federal/state protection

Past and current conservation actions

A summary of past and current conservation actions. This concerns previous and ongoing work undertaken by several individuals and organizations, relating to the Oaks of the Californias target species:

Past and current conservation action for *Q. cedrosensis*:

Otay Mountain Wilderness, a population of *Q. cedrosensis*, is a U.S. Wilderness Area (Wilderness status conferred on October 7, 1998 under Wilderness Act (Component of National Wilderness Preservation System) under US Dept of Interior Bureau of land management (BLM). Previous, current, and future scouting and monitoring efforts are being led by San Diego Botanic Garden in collaboration with San Diego Zoo Wildlife Alliance and other partners. From previous trips, acorns and cuttings have been successfully collected and distributed to several gardens to propagate and plant out, as well to conduct *in vitro* propagation. Additionally, the propagation technique of air layering to induce asexual reproduction has been conducted on one individual at the Otay population. Finally, samples have been collected to be sequenced for DNA analysis, which will give us a better understanding of the genetic variation within the wild populations.

Past and current conservation action for *Q. dumosa*:

San Diego Botanic Garden has naturally occurring *Q. dumosa* on site, and has permission to collect on San Diego county land. San Diego Zoo Wildlife Alliance is working on *in vitro*/micropropagation and eventually cryopreservation; *Quercus dumosa* acorns show a 95%+ germination rate *in vitro*. San Diego Botanic Garden planted *Q. dumosa* at a restoration project two years ago, which are now fully established. California Botanic Garden has two conservation groves of *Q. dumosa* established.

Past and current conservation action for *Q. engelmannii*:

The Huntington has *Q. engelmannii* as a site native and set aside 5.5. acra as an *in situ* preserve for the species. LA County Arboretum populations are also naturally occurring on site. The Arboretum is conducting a lot of survey/collecting work for *Q. engelmannii*, leading to the development and augmentation of several *ex situ*, living collections of *Q. engelmannii*, including the Royal Botanic Gardens Victoria in Australia. Additionally, the City of Encinitas has recruited local volunteers to add dozens of *Q. engelmannii* in a natural area of a local park. They are also planting climate resilient oak trees through multiple initiatives. The Curator, Jim, hopes to include the planting of *Q. engelmannii* through these efforts. Additionally, there are plans for *Q. engelmannii* to be collected from the extant populations in California. Dave Muffly with Oaktopia is actively propagating *Q. engelmannii* and planting as an urban street tree in the San Francisco Bay Area. There are discussions about including *Q. engelmannii* acorns through Dave's efforts to then distribute to municipalities to plant.

Past and current conservation action for *Q. pacifica*:

Over the past couple of years, there has been a lot of conservation action for *Q. pacifica* under the categories of sustainable land management, collection, and population monitoring. More specifically, hundreds of acorns have been collected, nursery grown and distributed to restoration sites managed by US Geological Survey (USGS/National Park Service Cloud Forest Restoration project, 12 acres across the Soledad Ridge of Santa Rosa Island and Catalina Island Conservancy (Bull Rush Canyon on Santa Catalina Island), and to gardens on mainland CA to establish in *ex situ*, living collections. The USGS restoration site will slow erosion, capture organic matter, so as to serve as seed bed for *Q. pacifica* and *Q. tomentella*. Additionally, there has been general population monitoring on Santa Rosa Island since the removal of deer to see how the *Q. pacifica* canopy has expanded. Santa Barbara Botanic Garden worked on mapping the distribution of *Q. pacifica* on Catalina Island previously. There are plans to do more vegetation mapping of Santa Catalina in the future.

Past and current conservation action for *Q. parvula*:

The island form of *Q. parvula* occurs on Santa Cruz Island so the populations are well protected there through the National Park Service. It is also a part of the California Conservation Genome Project in which whole genome sequencing is being done, led by Richard Dodd of UC Berkeley. Collecting trips have been led by Richard Dodd in which the material collected will be distributed to several *ex situ*, living collections.

Past and current conservation action for *Q. tomentella*:

The US Geological Survey and National Park Service is conducting a Cloud Forest restoration project, approximately 12 acres, for *Q. tomentella* on Santa Rosa Island. The objectives of the project include slowing erosion and capture of organic matter as it blows away across the ground surface, so that the development of litter can eventually serve as a seed bed for *Q. tomentella* and *Q. pacifica* acorns and other species. Plantings of *Q. tomentella* from seed and the nursery are included in the restoration project - all collected on the island. Also, vegetative mapping has been ongoing for *Q. tomentella*. A common garden experiment of *Q. tomentella*, incorporating material from other islands, is being established to look at the climate effects and the resilience of the species on other islands. The development of *Q. tomentella* conservation groves/collections is underway at several garden institutions. Additionally, *Q. tomentella* is being restored on Guadalupe Island, MX by the Group for Ecology and Island Conservation (GECI). On San Clemente, they have established three new restoration sites focusing on *Q. tomentella*, continuing to do acorn plantings. Also, Santa Barbara Botanic Garden, The Nature Conservancy

and University of California Santa Barbara conducted climate sustainability modeling on Santa Catalina, Santa Cruz, and Santa Rosa to identify future habitats for *Q. tomentella*.

Multi-Species Points of Intervention

Goals

*The overall goal is to **To implement the Oaks of the Californias' Action Plan** for the recovery of this species and a set of indicators to demonstrate when the targets have been achieved. Examples of Species level indicators are provided on the final page of this document.*

1. To better understand the relationships within and between these taxa we will conduct activities under the following themes:

- Identify locations of plants and species (gap analysis) including *ex situ* accessions
- Analyze how climate change might impact wild populations
- Gather more information on propagation techniques, habitat and climate preferences and soil type preferences
- Recruit new stakeholders to fill capacity gaps
- Conduct morphological/morphometric studies and genetic analysis

2. Gather more information to better understand the mechanisms that prohibit the regeneration and persistence of oaks, so we can intervene and mitigate these negative impacts so as to prevent further loss of individual oaks.

3. Coordinate collaborative, cross-sector collecting/surveying trips to ensure that the species' full range and genetic breadth is captured across living collections so that the species is well-conserved into the future, can be utilized for research and there is ample germplasm for future restoration efforts

4. Initiate education and outreach activities to inform a diverse group of stakeholders, stay abreast to current research and knowledge gaps, and be able to package the information into an easily digestible format.

5. Review current threat and protection statuses for each species to prioritize which species status needs to be elevated and better understand each listing process, so that each species can receive the proper monitoring and protection into the future.

Action statements:

Action Statement 1:

Threat:	Knowledge Gap: misidentification of species, lack of accurate native range distribution maps
Goal:	<p>To better understand the ecology of these taxa we will conduct activities under the following themes:</p> <ul style="list-style-type: none"> ● Identify locations of plants and species (gap analysis) including <i>ex situ</i> accessions ● Analyze how climate change might impact wild populations ● Gather more information on propagation techniques, habitat and climate preferences and soil type preferences ● Recruit new stakeholders to fill capacity gaps ● Conduct morphological/morphometric studies and genetic analysis
Actions:	<ol style="list-style-type: none"> 1. Identify locations of plants and species (gap analysis) including <i>ex situ</i> accessions (ongoing) <ol style="list-style-type: none"> a. Mapping known or possible locations, revisit historical occurrences and protected sites <ol style="list-style-type: none"> i. To better understand the relationships within and between these taxa we will Identify location (in US and MX) of plants and species (partly gap analysis) ii. Gather more information on the known protection status of regions iii. Confirm the identification of <i>ex situ</i> accessions b. Environmental niche modeling--help to show where to collect (in the near future, need more resources) 2. Analyze how climate change might impact the wild populations (in the near future, need more resources) <ol style="list-style-type: none"> a. climate modeling-- how climate change might impact the wild populations <ol style="list-style-type: none"> i. Need to identify a researcher working on this b. Research to better understand effects of climate change on species' range c. Review IUCN Red List of U.S. Oaks for climate related data and descriptors d. Engage with Indigenous communities to expand the understanding of the impacts of climate change on the resilience of populations through Traditional Ecological Knowledge 3. Recruit new stakeholders (ongoing) <ol style="list-style-type: none"> a. Promote the action plan and the work that this group is doing via social media, presentations, newsletters, etc. 4. Conduct morphological/morphometric studies and genetic analysis (ongoing, need more resources) <ol style="list-style-type: none"> a. Compare herbarium voucher holdings to determine whether enough specimens are present to accurately reflect natural variation within each taxon b. Conduct field studies and collections to supplement and update herbarium holdings and genetic samples necessary for documenting morphological variation within species c. Understanding gene flow and potential hybridization d. Population genetics: molecular analysis of wild individuals and individuals in living collections and compare the two e. Submit another round of funding for more whole genome sequencing for species that were not included in the first round

Responsible parties	<ul style="list-style-type: none"> ● San Diego Zoo Wildlife Alliance (1, 4, 5) ● San Diego Botanic Garden (1, 4, 5) ● LA County Arboretum (1, 4, 5) ● UC Berkeley (1, 4, 5) ● CNPS (1, 4, 5) ● UCLA (1, 4, 5) ● TNC (1, 4, 5) ● San Diego Natural History Museum (1, 4, 5) ● Catalina Island Conservancy (1, 4, 5)
Timeline	<ul style="list-style-type: none"> ● 2022-2026
Expected outcome	<ul style="list-style-type: none"> ● More informed collecting in the future to ensure the full range of the species is captured in collections and can be considered for ● Niche modeling will help to show where to collect ● Develop most accurate and current understanding of <i>ex situ</i> holdings ● With climate modeling, it may protect collections from imposed water restrictions ● Better understand the effects of climate change on species range ● Identify appropriate <i>ex situ</i> sites for future climate conditions ● Compilation of existing informational resources related to propagation culture in a single location ● More partners supporting/contributing to the actions laid out in the plan ● Baseline understanding of whether current herbarium holdings suffice for morphometric studies
Collaborators	<ul style="list-style-type: none"> ● UC Santa Cruz (2) ● Indigenous communities (2) ● INPACVI (1)
Obstacles:	<ul style="list-style-type: none"> ● Resource intensive (travel and staff time) to visit many occurrences ● Limited expertise within existing working group for climate and niche modeling; need for supplemental expertise
Monitor progress method(s): (e.g. regular reports/updates)	<ul style="list-style-type: none"> ● Annual check-in meeting ● Five year check-in to update progress made, make changes accordingly to the outlined activities
Indicators of success (so all stakeholders know this action was completed)	<ul style="list-style-type: none"> ● Increased and agreed upon understanding across experts of the species native range, what it hybridizes with and resolving taxonomic challenges/questions ● One climate modeling study successfully funded and underway

	<ul style="list-style-type: none"> ● One environmental niche study successfully funded and underway ● Established database that is accessible by oak experts to upload, share and gather information that go towards the development of updated range maps ● Established database or platform that shares information on propagation techniques and planting recommendations (e.g. habitat and soil preferences for each species) ● 10 new partners/collaborators join the action plan group efforts
Important considerations:	<ul style="list-style-type: none"> ● Possibility of recruiting volunteers and/or students

Action Statement 2	
Threat:	Invasive woody/herbaceous species, Non-native animals/grazing
Goal:	Gather more information to better understand the mechanisms that prohibit the regeneration and persistence of oaks, so we can intervene and mitigate these negative impacts so as to prevent further loss of individual oaks.
Actions:	<ol style="list-style-type: none"> 1. All non-native herbivores are removed from all islands and guidelines for grazing on mainland where it occurs (ongoing, in the near future) <ol style="list-style-type: none"> a. Understand the current capacity and activities that are being conducted to manage/mitigate impacts from invasive pests/herbivores b. Developing best practices for managing invasives, if needed, or replicating these practices -- having more boots on the ground to do this work 2. Research on bio-controls/gene controls for invasives (ongoing) <ol style="list-style-type: none"> a. Engage with CA Invasive Plant Council (CALIPC) b. Research on bio-controls/gene controls for invasives, figure out what is needed/what is being done/what is known c. Develop biosecurity protocols for oak research and conservation (specifically for the islands) 3. Monitor for invasive pathogens (ongoing) <ol style="list-style-type: none"> a. Understanding species needs (populations difficult to get to), overcome these obstacles to monitor these populations, prioritize populations for monitoring (e.g. if they are more threatened) b. Utilizing iNaturalist or another platform for people to indicate any symptoms of pests/pathogens with the species of focus c. Engage with working groups, Phytophthora working group d. Invasive Weed Watch through San Diego County 4. Educating audiences on invasive species (ongoing, need more resources) <ol style="list-style-type: none"> a. Educate border patrol and utility companies on their management practices and how they contribute to invasive

	<p>species spread with their activities</p> <p>b. Educate general public about the impacts of invasive species-- produce a guide with info from pathologists that outline the symptoms/signs of pests</p> <p>c. Educate hort industry/ create species lists that are banned from commercial nursery production</p> <p>d. Present at webinars, conferences (e.g. CALIPC)</p> <p>e. Invasive Weed Watch through San Diego County sharing information</p>
Responsible parties	<ul style="list-style-type: none"> ● TNC (1, 2c, 3, 4) ● Catalina Island Conservancy (1, 2c, 3, 4) ● National Park Service (1, 2c, 3, 4)
Timeline	<ul style="list-style-type: none"> ● 2022-2026
Expected outcome	<ul style="list-style-type: none"> ● Preventing introduction of new invasives to the islands ● More awareness about the invasive pests, and being more conscious about what activities/practices to avoid doing to increase the spread, and encourage monitoring of pests
Collaborators	<ul style="list-style-type: none"> ● USFS Region 5, Region 6 (3, 4) ● CALFIRE (2, 3, 4) ● BGCI-US (4) ● CA Invasive Plant Council (2, 3, 4) ● CNPS (3, 4) ● INPACVI (4)
Obstacles	<ul style="list-style-type: none"> ● Implementing biosecurity protocols for the islands and ensuring their sustainability will be a difficult challenge to monitor and keep track of over time ● Monitoring for invasive pests for all of the priority species will take a lot of time and effort – will require funds and support from several organizations
Monitor progress method(s): (e.g. regular reports/updates)	<ul style="list-style-type: none"> ● Annual check-in meeting ● Five year check-in to update progress made, make changes accordingly to the outlined activities
Indicators of success (so all stakeholders know this action was)	<ul style="list-style-type: none"> ● The successful removal of vertebrate pests on Catalina Island ● Biosecurity protocols are successfully implemented and followed ● A monitoring plan for each species is developed and followed

completed)	<ul style="list-style-type: none"> Engaged local community support for monitoring and identifying pests through iNaturalist or another community science platform
Important considerations	<ul style="list-style-type: none"> With invasive pests and pathogens we need to be proactive in this work so we can get ahead of any new and devastating pests/pathogens that could have irreversible impacts

Action Statement 3	
Threat	Low representation across species in collections, low acorn production in the wild
Goal:	Coordinate collaborative, cross-sector collecting/surveying trips to ensure that the species' full range and genetic breadth is captured across living collections so that the species is well-conserved into the future, can be utilized for research and there is ample germplasm for future restoration efforts
Actions	<ol style="list-style-type: none"> Have a centralized area to share information on accessions and phenological data (in the near future) <ol style="list-style-type: none"> utilize the PlantSearch Pedigree Module to upload accession level data <ol style="list-style-type: none"> Short-term solution, have a shared folder of data Training on PlantSearch Pedigree Module Connect germplasm suppliers to those who use them for reforestation/restoration/ex situ collections Share information on accessions and gps coordinates (ongoing) Ensure collections are genetically diverse-- identifying which populations have not been collected from, which populations/individuals need more representation (updating gap analysis data) (ongoing) Develop protocols for in vitro and cryopreservation for embryos, shoot tips, pollen (ongoing, need more resources) <ol style="list-style-type: none"> Adapt technologies from other taxa and apply to oak taxa such as tissue culture, cryopreservation, propagation, cold storage of seedlings/cuttings, etc. to better improve sampling species for conservation/research purposes Include in-vitro collections of living plants (TC) for germplasm storage and propagules Training staff on these protocols Endophytic fungal contamination Engage garden partners and other organizations to provide shoot tip material Gathering more information on propagation techniques, habitat and climate preferences, and soil type preferences from living collection accessions (ongoing) <ol style="list-style-type: none"> Identify and use a database to hold this important information (in the near future) <ol style="list-style-type: none"> Align with CALSCAPE CNPS product

	<ul style="list-style-type: none"> ii. Align with BGCI Propagation Module iii. Align with CPC Rare Plant Academy iv. Identify other databases/platforms that are tracking/compiling propagation data <p>b. Identify gaps in data and determine how to fill them</p> <p>4. Identify refugia institutions (ongoing, need more resources)</p> <ul style="list-style-type: none"> a. Gather information on the environment where the plant grows, so we can identify sites with similar environmental conditions b. Work with niche modelers to determine outplanting sites; better match with niche variability c. Connect with NGOs, the USFS, etc., organizations with space to host conservation grove of these species <p>5. Use <i>ex situ</i> collections for education and research (ongoing, need more resources)</p> <ul style="list-style-type: none"> a. Conduct genetic studies on the collections (e.g. population genetic studies) <ul style="list-style-type: none"> i. Population genetics: molecular analysis of wild individuals and individuals in living collections and compare the two ii. Identifying core genetic populations—Highlighting populations that require more legal protection and knowing what populations to sample over others b. Engage in education and outreach opportunities utilizing the collections (have guided interpretation signage emphasizing the importance of the collections, etc.)
Responsible parties	<ul style="list-style-type: none"> ● BGCI (1, 3) ● San Diego Zoo Wildlife Alliance (1, 2, 3, 4b)
Timeline	<ul style="list-style-type: none"> ● 2022-2026
Expected outcome	<ul style="list-style-type: none"> ● Data compiled here can be shared with the appropriate stakeholders to utilize for future, informed collecting trips ● Better improve sampling species for conservation/research species ● Island species are well-conserved in sites on the mainland to serve as back-up given climate change impacts, etc. ● Have a better understanding of how much genetic diversity is captured in living collections ● More people are aware of the species and willing to support future conservation/research work
Collaborators	<ul style="list-style-type: none"> ● Cincinnati Zoo and Botanical Garden (2, 3) ● The Huntington (1, 2, 3, 4b) ● San Diego Botanic Garden (1, 3, 4a) ● San Francisco Botanic Garden (1, 3, 4a) ● UC Berkeley (1, 2, 3, 4a) ● UCLA (1, 2, 3, 4a) ● The Morton Arboretum (4a)

	<ul style="list-style-type: none"> ● USFS Region 5, Region 6 (3, 4) ● CPC (3) ● Indigenous communities (4) ● The Wildlands Conservancy (4) ● INPACVI (4, 5)
Obstacles	<ul style="list-style-type: none"> ● Not enough people doing in vitro propagation (more technicians needed -> more funding support) ● Need more researchers/funding to do genetic analysis studies
Monitor progress method(s): (e.g. regular reports/updates)	<ul style="list-style-type: none"> ● Annual check-in meeting ● Five year check-in to update progress made, make changes accordingly to the outlined activities
Indicators of success (so all stakeholders know this action was completed)	<ul style="list-style-type: none"> ● Central repository will make data sharing easier and knowing what we captured in living collections—how much genetic diversity is captured ● Getting more people to care (more popular support) leading to better protection and making people feel like they have a stake in these efforts ● Engaging popular science
Important considerations	<ul style="list-style-type: none"> ● PlantSearch 2.0 for BGCI will hold accessions-level data-- the GCCO will be an audience to provide data to test out this new tool, so this will serve as the database to track accessions level data (expected to launch late 2022) ● In vitro and other propagation methods are time sensitive ● In vitro and other propagation methods keep material safe from environmental factors and you can store more genetic diversity in less space ● Having access to wild specimens for propagation testing ● Propagating enough (in those <i>ex situ</i> collections) so that we have enough genetic material ● Don't want to disclose really rare/threatened species locations to public

Action Statement 4

Threat:	Development and natural systems modification, leading to habitat loss
Goal:	Initiate education and outreach activities to inform a diverse group of stakeholders, stay abreast to current research and knowledge gaps, and be able to package the information into an easily digestible format, to resolve issues such as development, habitat loss and natural system modification
Actions:	<ol style="list-style-type: none"> 1. Engage Indigenous communities to align where possible on these actions (ongoing) <ol style="list-style-type: none"> a. With the guidance from Indigenous partners, include Traditional Ecological Knowledge in education/outreach materials/opportunities 2. Engage with farmers, other land managers and private landowners (need more resources) 3. Attend/present on this action plan where applicable (in the near future) <ol style="list-style-type: none"> a. For professional organizations, at conferences, webinars, workshops, etc. 4. Sharing skill sets and research among collaborators (ongoing) <ol style="list-style-type: none"> a. Host workshops/meetings to have a space for collaborators to share skill sets b. Develop a common forum for sharing written & photographic feedback (successful & unsuccessful experience/advice) c. Help promote & advertise planned events that align with this work d. Develop print media to engage more professionals e. Align with BGCI's current efforts to develop guidance briefs on oak conservation topics such as collecting, propagation, etc. as well as their efforts to develop training modules -- have a module on some of the work focused around channel island oaks 5. Provide online/in-person training opportunities for the public (ongoing, need more resources) <ol style="list-style-type: none"> a. Training on oak species, providing a high-level overview of the species, how to ID them, etc. <ol style="list-style-type: none"> i. Engage land managers with Q. spp. on their land ii. Link these trainings to the common forum so we can identify people who can lead these trainings iii. Brainstorm ways to advertise these training opportunities iv. Record trainings and upload to website resources b. Sharing success stories, or historical origin stories for the species <ol style="list-style-type: none"> i. Message told through/with Ex-situ groves (interpretive events & signage) ii. Print media to engage the public
Responsible parties	<ul style="list-style-type: none"> ● GCCO Coordinator (1, 2, 3, 4, 5) ● BGCI-US (1, 2, 3, 4, 5) ● CNPS (1, 2, 3, 4, 5) ● The Wildlands Conservancy (2, 4, 5) ● INPACVI (1, 2, 5)

Timeline	<ul style="list-style-type: none"> ● 2022-2026
Expected outcome	<ul style="list-style-type: none"> ● Broaden base of awareness, support, and activism ● Collaborators are more connected and coordinated in their work, sharing and spreading knowledge/, could foster new partnerships and projects ● More stakeholders, such as public agency employees, subcontractors, land and road managers, are more aware of the species, their threat status, what and why to avoid removing them and could increase the species representation in urban landscapes, etc. ● Reaching audiences via a more artistic/emotional route, elicit more interest towards the species
Collaborators	<ul style="list-style-type: none"> ● Indigenous communities (1, 5) ● Oaks of the Californias' Working Group (1, 2, 3, 4, 5)
Obstacles	<ul style="list-style-type: none"> ● Making connections to private landowners and farmers
Monitor progress method(s): (e.g. regular reports/updates)	<ul style="list-style-type: none"> ● Annual check-in meeting ● Five year check-in to update progress made, make changes accordingly to the outlined activities
Indicators of success (so all stakeholders know this action was completed)	<ul style="list-style-type: none"> ● Recruit more partners to learn more about the status of these oak species on private lands, etc., and collaborate with them on this action plan ● Present the action plan and successfully recruit more support such as more partners, funding, etc., as a result ● Host >10 online/in-person training workshops focused on oaks and oak conservation
Important considerations	<ul style="list-style-type: none"> ● Building relationships with new partners takes time, so these activities will be over a longer period of time

Action Statement 5	
Threat:	Lack of federal/state protection
Goal:	Review current threat and protection statuses for each species to prioritize which species status needs to be elevated and better understand each listing process, so that each species can receive the proper monitoring and protection into the future.
Actions:	1. Conduct literature reviews and research to know what statuses are currently listed for each species (ongoing)

	<ol style="list-style-type: none"> 2. Learn more about each listing process to understand which information needs to be gathered to move forward with the identified listings (ongoing) 3. Learn more about the process to incorporate the species into Natural Community Conservation Plans (NCCPs) (ongoing) 4. Create a model workflow on the listing process for each threat/protection status so that this can be replicated for future listings for additional priority oak species in the future (in the near future) 5. Align with the California 30x30 initiative (ongoing indefinitely)
Responsible parties	<ul style="list-style-type: none"> ● CNPS (1, 2) ● SDZWA
Timeline	<ul style="list-style-type: none"> ● 2022-2026
Expected outcome	<ul style="list-style-type: none"> ● Sufficient information is gathered on what information is needed for each species to pursue an elevated threat status and/or petition for listing on the State or Federal Endangered Species list ● A workflow is developed so that the process to pursue listing/threat status elevation can be easily replicated across each species
Collaborators	<ul style="list-style-type: none"> ● The Wildlands Conservancy (1, 2)
Obstacles	<ul style="list-style-type: none"> ● The listing process is time-consuming and takes a long time, so we need to ensure we have the personnel and funds to pursue this over the designated period of time
Monitor progress method(s): (e.g. regular reports/updates)	<ul style="list-style-type: none"> ● Annual check-in meeting ● Five year check-in to update progress made, make changes accordingly to the outlined activities
Indicators of success (so all stakeholders know this action was completed)	<ul style="list-style-type: none"> ● More than one of the six priority species has an elevated threat status or it is officially listed under the State or Federal Lists so it receives more protection
Important considerations	<ul style="list-style-type: none"> ● The information to gather for each species will vary, so the workflow developed needs to be broad and evergreen in its format

Summary of Multi-Species Actions

The detailed activities (those that are “ongoing” or will take place “in the near future”) that will be required to contain, reduce or eliminate the threats and ensure the maintenance of viable populations of the species. The listed goals they relate to in [brackets].

Activities [To better understand the relationships within and between these taxa...]	Timeframe				
	2022	2023	2024	2025	2026
1. Identify locations of plants and species (gap analysis) including <i>ex situ</i> accessions	<p>Mapping known or possible locations, revisit historical occurrences and protected sites</p> <p>Confirm the identification of <i>ex situ</i> accessions</p> <p>Gather more information on the known protection status of regions</p>	<p>Mapping known or possible locations, revisit historical occurrences and protected sites</p> <p>Verify the identification of <i>ex situ</i> accessions</p> <p>Gather more information on the known protection status of regions</p> <p>Environmental niche modeling of <i>ex situ</i> long-term survival</p>	<p>Mapping known or possible locations, revisit historical occurrences and protected sites</p> <p>Verify the identification of <i>ex situ</i> accessions</p> <p>Gather more information on the known protection status of regions</p> <p>Environmental niche modeling of <i>ex situ</i> long-term survival</p>	<p>Environmental niche modeling of <i>ex situ</i> long-term survival</p>	
2. Analyze how climate change might impact the wild populations	<p>Review IUCN Red List of U.S. Oaks for climate related data and descriptors</p>	<p>Climate modeling-- how climate change might impact the wild populations (hire/work with a climate modeler)</p>	<p>Climate modeling-- how climate change might impact the wild populations</p> <p>Research to better understand effects</p>		

		Research to better understand effects of climate change on range	of climate change on range		
3. Recruit new stakeholders	Promote the action plan and the work that this group is doing via social media, presentations, newsletters, etc.				
4. Conduct morphological/morphometric studies and genetic analysis	<p>Compare herbarium voucher holdings to determine whether enough specimens are present to accurately reflect natural variation within each taxon</p> <p>Conduct field studies and collections to supplement and update herbarium holdings and genetic samples necessary for documenting morphological variation within species</p> <p>Understanding gene flow and potential hybridization</p>	<p>Compare herbarium voucher holdings to determine whether enough specimens are present to accurately reflect natural variation within each taxon</p> <p>Conduct field studies and collections to supplement and update herbarium holdings and genetic samples necessary for documenting morphological variation within species</p> <p>Understanding gene flow and potential hybridization</p> <p>Submit another round of funding for more whole genome sequencing for species that were not included in the first round</p>	<p>Compare herbarium voucher holdings to determine whether enough specimens are present to accurately reflect natural variation within each taxon</p> <p>Conduct field studies and collections to supplement and update herbarium holdings and genetic samples necessary for documenting morphological variation within species</p> <p>Understanding gene flow and potential hybridization</p> <p>Population genetics: molecular analysis of wild individuals and individuals in living collections and</p>	<p>Compare herbarium voucher holdings to determine whether enough specimens are present to accurately reflect natural variation within each taxon</p> <p>Conduct field studies and collections to supplement and update herbarium holdings and genetic samples necessary for documenting morphological variation within species</p> <p>Understanding gene flow and</p>	

		Population genetics: molecular analysis of wild individuals and individuals in living collections and compare the two	compare the two	potential hybridization	
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Activities [Gather more information to better understand the mechanisms that prohibit the regeneration and persistence of oaks, so we can intervene and mitigate these negative impacts so as to prevent further loss of individual oaks.]	Timeframe				
	2022	2023	2024	2025	2026
1. All non-native herbivores are removed from all islands and guidelines for grazing on mainland where it occurs	Understand the current capacity and activities that are being conducted to manage/mitigate impacts from invasive pests/herbivores Developing best practices for managing invasives, if needed, or replicating these practices -- having more boots on the ground to do this work	Developing best practices for managing invasives, if needed, or replicating these practices -- having more boots on the ground to do this work			
2. Research on bio-controls/gene controls for invasives	Engage with CA Invasive Plant Council (CALIPC) Research on bio-controls/gene controls for invasives, figure out what is needed/what is being done/what is k	Develop biosecurity protocols for oak research and conservation (specifically for the islands)	Develop biosecurity protocols for oak research and conservation (specifically for the islands)		

3. Monitor for invasive pathogens	Engage with working groups, Phytophthora working group Invasive Weed Watch through San Diego County			
4. Educating audiences on invasive species	<p>Educate border patrol and utility companies on their management practices and how they contribute to invasive species spread with their activities</p> <p>Educate general public about the impacts of invasive species-- produce a guide with info from pathologists that outline the symptoms/signs of pests</p> <p>Educate hort industry/ create species lists that are banned from commercial nursery production</p> <p>Present at webinars, conferences (e.g. CALIPC)</p>			

Activities [Develop a targeted, organized, and coordinated plan to ensure that the species' full range and genetic breadth is captured across living collections so that the species is well-conserved into the future, can be utilized for research, and there is ample seed for future restoration efforts.]	Timeframe				
	2022	2023	2024	2025	2026
1. Have a centralized area to share information on accessions and phenological data	<p>Short-term solution, have a shared folder of data</p> <p>Share information on accessions and gps coordinates—lead to updated spatial analysis maps</p>	<p>Training on PlantSearch Pedigree Module</p> <p>Share information on accessions and gps coordinates—lead to updated spatial analysis maps</p>	<p>Training on PlantSearch Pedigree Module</p> <p>Share information on accessions and gps coordinates—lead to updated spatial analysis maps</p>	<p>Share information on accessions and gps coordinates—lead to updated spatial analysis maps</p>	<p>Share information on accessions and gps coordinates—lead to updated spatial</p>

					analysis maps
2. Develop protocols for in vitro and cryopreservation for embryos, shoot tips, pollen	Develop protocols for in vitro and cryopreservation for embryos, shoot tips, pollen				
3. Gathering more information on propagation techniques, habitat and climate preferences, and soil type preferences from living collection accessions		Identify and use a database to hold this important information; Align with CALSCAPE CNPS product; Align with BGCI Propagation Module; Align with CPC Rare Plant Academy Identify other databases/platforms that are tracking/compiling propagation data	Identify and use a database to hold this important information; Align with CALSCAPE CNPS product; Align with BGCI Propagation Module; Align with CPC Rare Plant Academy Identify other databases/platforms that are tracking/compiling propagation data		
4. Identify refugia institutions	Identify refugia institutions Connect with NGOs, the USFS, etc., organizations with space to host conservation grove of these species	Identify refugia institutions Connect with NGOs, the USFS, etc., organizations with space to host conservation grove of these species Work with niche	Identify refugia institutions Connect with NGOs, the USFS, etc., organizations with space to host conservation grove of these species Work with niche		

		modelers to determine outplanting sites; better match with niche variability	modelers to determine outplanting sites; better match with niche variability		
5. Use <i>ex situ</i> collections for education and research	Engage in education and outreach opportunities utilizing the collections (have guided interpretation signage emphasizing the importance of the collections, etc.)	Conduct genetic studies on the collections (e.g. population genetic studies) Engage in education and outreach opportunities utilizing the collections (have guided interpretation signage emphasizing the importance of the collections, etc.)	Conduct genetic studies on the collections (e.g. population genetic studies)		

Activities [Initiate education and outreach activities to inform a diverse group of stakeholders, stay abreast to current research and knowledge gaps, and be able to package the information into an easily digestible format.]	Timeframe				
	2022	2023	2024	2025	2026
1. Engage indigenous communities/organizations to align where possible on these actions	Engage indigenous communities/organizations to align where possible on these actions Nominate coordinator/representative for local/indigenous outreach; Invite local/indigenous	Engage indigenous communities/organizations to align where possible on these actions Engage with farmers, other land managers and private landowners Attend/present on this action			

	<p>participants directly to the GCCO</p> <p>Engage with farmers, other land managers and private landowners</p> <p>Attend/present on this action plan where applicable</p>	<p>plan where applicable</p>			
<p>2. Sharing skill sets and research among collaborators</p>	<p>Host workshops/meetings to have a space for collaborators to share skill sets</p> <p>Develop print media to engage more professionals</p> <p>Align with BGCI's current efforts to develop guidance briefs on oak conservation topics such as collecting, propagation, etc. as well as their efforts to develop training modules</p>	<p>Host workshops/meetings to have a space for collaborators to share skill sets</p> <p>Develop print media to engage more professionals</p> <p>Develop a common forum for sharing written & photographic feedback (successful & unsuccessful experience/advice)</p> <p>Align with BGCI's current efforts to develop guidance briefs on oak conservation topics such as collecting, propagation, etc. as well as their efforts to develop training modules -- have a module on some of the work focused around channel island oaks</p>	<p>Host workshops/meetings to have a space for collaborators to share skill sets</p>	<p>Host workshops/meetings to have a space for collaborators to share skill sets</p>	<p>Host workshops/meetings to have a space for collaborators to share skill sets</p>

3. Provide online/in-person training opportunities for the public	Sharing success stories Training on oak species, providing a high-level overview of the species, how to ID them, etc.
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Activities [Review current threat and protection statuses for each species to prioritize which species status needs to be elevated and better understand each listing process, so that each species can receive the proper monitoring and protection into the future.]	Timeframe				
	2022	2023	2024	2025	2026
1. Conduct literature reviews and research to know what statuses are currently listed for each species	Conduct literature reviews and research to know what statuses are currently listed for each species				
2. Learn more about each listing process to understand which information needs to be gathered to move forward with the identified listings	Learn more about each listing process to understand which information needs to be gathered to move forward with the identified listings				
3. Create a model workflow on the listing process for each threat/protection status so that this can be replicated for future listings for additional priority oak species in the future		Create a model workflow on the listing process for each threat/protection status so that this can be replicated for future listings for additional priority oak species in the future			
4. Align with the California 30x30 initiative					

Species-specific profiles

For each species, we developed specific action tables that are priority actions we must take for each individual species. They are linked below.

[Quercus cedrosensis](#)

[Quercus dumosa](#)

[Quercus engelmannii](#)

[Quercus pacifica](#)

[Quercus parvula](#)

[Quercus tomentella](#)

Collaborating Institutions

- Botanic Gardens Conservation International-US
- CA Invasive Plant Council
- CALFIRE
- California Native Plant Society
- Catalina Island Conservancy
- California Wildlife Foundation/California Oaks
- Center for Plant Conservation
- Cincinnati Zoo and Botanical Garden
- Indigenous communities
- LA County Arboretum
- National Park Service
- San Diego Botanic Garden
- San Diego Zoo Wildlife Alliance
- San Diego Natural History Museum
- San Francisco Botanic Garden
- The Huntington Library, Art Museum, and Botanical Gardens
- The Morton Arboretum
- The Nature Conservancy
- The Wildlands Conservancy
- UC Berkeley

- University of California Los Angeles
- UC Santa Cruz
- USFS Region 5, Region 6
- Viejas Tribal Government

References

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