

# Conservation Gap Analysis of Native Mesoamerican Oaks



## Species profile: *Quercus cedrosensis*

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### CRITICALLY ENDANGERED

*Quercus graciliformis*  
*Quercus mulleri*

### ENDANGERED

*Quercus brandegeei*  
*Quercus carmenensis*  
*Quercus cualensis*  
*Quercus cupreata*  
*Quercus delgadoana*  
*Quercus devia*  
*Quercus diversifolia*  
*Quercus dumosa*  
*Quercus engelmannii*  
*Quercus flocculenta*  
*Quercus galeanensis*  
*Quercus hintonii*  
*Quercus hirtifolia*  
*Quercus insignis*  
*Quercus macdougallii*  
*Quercus miquihuanensis*  
*Quercus nixoniana*  
*Quercus radiata*  
*Quercus runcinatifolia*  
*Quercus tomentella*

### VULNERABLE

*Quercus acutifolia*  
*Quercus ajoensis*  
***Quercus cedrosensis***  
*Quercus costaricensis*  
*Quercus gulielmi-treleasei*  
*Quercus hintoniorum*  
*Quercus meavei*  
*Quercus rubramenta*  
*Quercus tuitensis*  
*Quercus vicentensis*



THE  
CHAMPION  
of TREES



# *Quercus cedrosensis* C.H.Müll.

Common Names, English: Cedros Island Oak

IUCN Red List Category and Criteria: Vulnerable: B2ab(ii,iii,iv)

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## DISTRIBUTION AND BIOLOGY

*Quercus cedrosensis*, or Cedros Island Oak, is native to Baja California and Cedros Island, from which it was named (Figure 1). Originally thought to be endemic to Mexico, a small population was recently discovered in the United States in San Diego County near the border with Mexico in the Otay Mountain Wilderness (Roberts, 2022). In Baja California, most populations are concentrated near Tijuana, Ensenada, and San Vicente in the northern half of the state and southwest of Bahía de Los Angeles as well as Cedros Island further south. There is one unverified occurrence near the border of Baja California Sur that deserves further

investigation. The Sierra de la Asamblea is also a region that should be explored further. Recent survey work to the site did not find any individuals of *Q. cedrosensis* but the area is very large, and deserving of future exploration.

*Quercus cedrosensis* is an evergreen tree or shrub that can grow up to 5 m (Rosatti and Tucker, 2014). Leaves are typically less than 2.5 cm long and are glabrous with white veins (Muller, 1962). They can be lanceolate, ovate, oblong, elliptic, or subround (Rosatti and Tucker, 2014; Roberts, 2022). The acorns are 15–22 mm long and 6–10 mm broad and mature in the second year (Muller, 1962). This species has a wide elevation tolerance and can be found in both lowland and mountainous regions. In California and Baja California, *Q. cedrosensis* is typically at elevations from 75–1,000 m asl, occasionally up to 1,400 m asl (Kenny et al., 2017). Its typical habitat is chaparral, closed-cone coniferous forest, or coastal shrub (CNPS, 2023). A majority of wild occurrences are found within the warm temperate thorn scrub life zone (Figure 2).

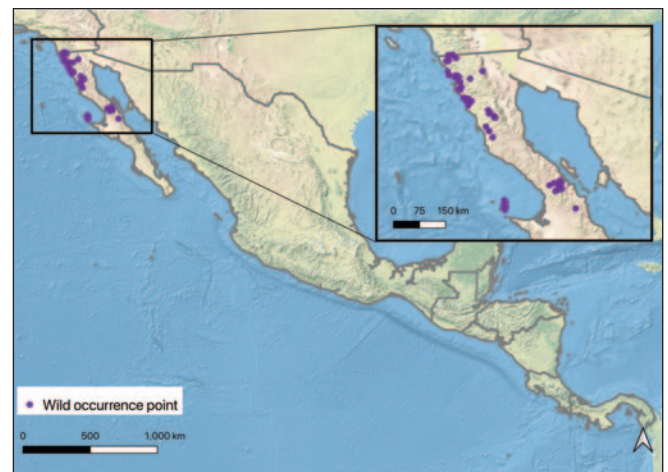
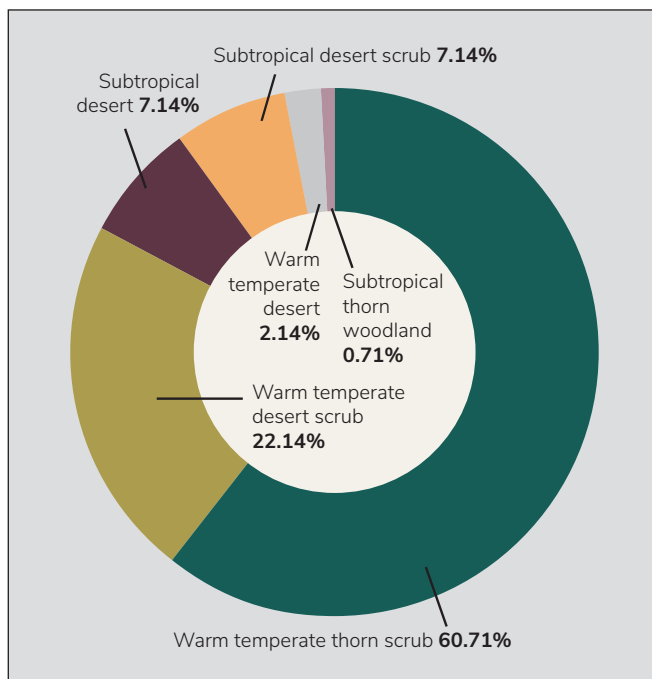


Figure 1. Wild (i.e., in situ) occurrence points for *Quercus cedrosensis*.



**Figure 2.** The percentage of wild occurrence points in each Holdridge life zone in which *Quercus cedrosensis* is distributed.

## THREATS TO WILD POPULATIONS

**Human use of species — wild harvesting:** This is not currently considered a threat.

**Human use of landscape — agriculture, silviculture, ranching, and/or grazing:** There is agriculture in the habitat in which *Q. cedrosensis* is found in the mainland. However, the species is primarily distributed in steep rocky hills in areas that would be difficult for grazing animals to access. This is not currently a major threat.

**Human use of landscape — residential/commercial development, mining, and/or roads:** On the mainland, habitat loss due to land use changes is the primary threat faced by *Q. cedrosensis*. These changes include road construction, Border Patrol activities, and urban and rural development (CNPS, 2001). Northern Baja California is one of the fastest growing urban areas within Mexico. There is currently little to no restriction on development and a lack of regulation related to construction. Permits are often issued without fully considering the environmental impacts.

Ejidos are areas of communal land used for agriculture. As of 1994, ejidos are allowed to sell parcels of land, and the first ejidos to begin selling were those located on the coast. Recently inland ejidos have begun to follow suit. Purchasing

country plots is increasingly popular with people from the city who are looking for a country home. This promotes landscape fragmentation and increases the probability of forest fires. There is a need to share information with the commissioners in the ejidos so that they can make more informed decisions.

**Human use of landscape — tourism and/or recreation:** There are hiking trails within the native range of *Q. cedrosensis*, and mountain biking has become increasingly popular within the last decade. Currently, tourists are educated on natural ecosystem services and fires as an ecological process. More education on the local threatened flora and fauna is needed.

**Human modification of natural systems — altered fire regime, pollution, eradication:** Certain populations in the mainland are threatened by wastewater pollution. Rapid urban development within northern Baja California is putting a strain on the aging sewage infrastructure. As a result, wastewater is released back into the surrounding aquatic environment without proper processing.

Wildfires are also a concern within the habitat of *Q. cedrosensis*. The typical fire disturbance regime in chaparral is 40 to 50 years and the Baja California Forest is 15 to 20 years. However, human activities are shortening the time between fires, preventing species from reaching sexual maturity. Fire also causes habitat fragmentation and isolates species.

**Human modification of natural systems — invasive species competition/disturbance:** There are invasive weeds, grasses, and grazing animals (goats) on the Mexican mainland. Historically there were donkeys and goats on Cedros Island, but they are no longer found here. Rats have been reported, but they tend to live in populated areas and are not a threat to *Q. cedrosensis* on Cedros Island.

**Climate change — habitat shifting, drought, temperature extremes, and/or flooding:** A recent study found that *Q. cedrosensis* is expected to lose more than 12% of suitable habitat under future climate change scenarios (Ramírez-Preciado et al., 2019). The warm temperate thorn scrub is especially threatened by climate change. This life zone is expected to decrease in area by an average of 71% by the years 2061–2080 relative to current conditions (Good et al., 2024). The region in which *Q. cedrosensis* grows is experiencing a shorter rainy season with a reduced snowpack.

**Genetic material loss — inbreeding and/or introgression:** Unknown.

**Pests and/or pathogens:** Researchers from the San Diego Zoo Wildlife Alliance (SDZWA) have noticed an acorn gall maker on acorns of *Q. cedrosensis* from California, and are awaiting confirmation of identification. There is also evidence of acorns being feeded on by an unknown animal(s), as holes have been observed in acorn bags.

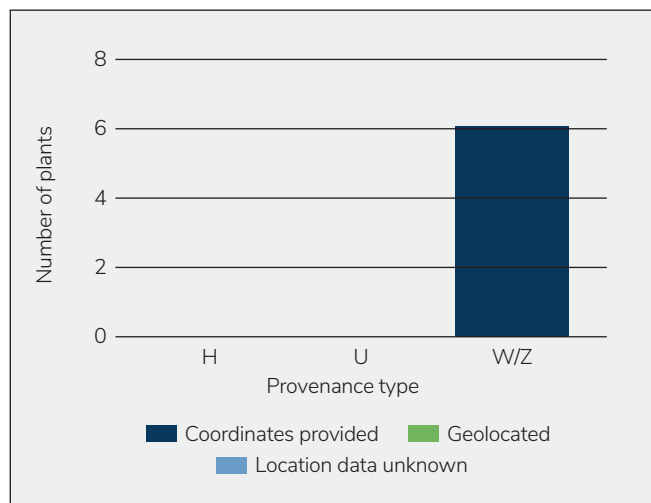
**Extremely small and/or restricted population:** *Quercus cedrosensis* is typically restricted to areas near aquifers and arroyos. More survey work is needed to better understand if restricted populations are a threat.

## CONSERVATION ACTIVITIES

Once per year between 2017 and 2022, *Quercus* accessions data were requested from ex situ collections globally. A total of 197 institutions from 27 countries submitted data for Mesoamerican oak species, including *Q. cedrosensis* (Table 1, Figure 3). Past, present, and planned conservation activities for Mesoamerican oak species of concern were also examined through literature review and expert consultation.

**Table 1.** Results of 2017–2022 ex situ surveys.

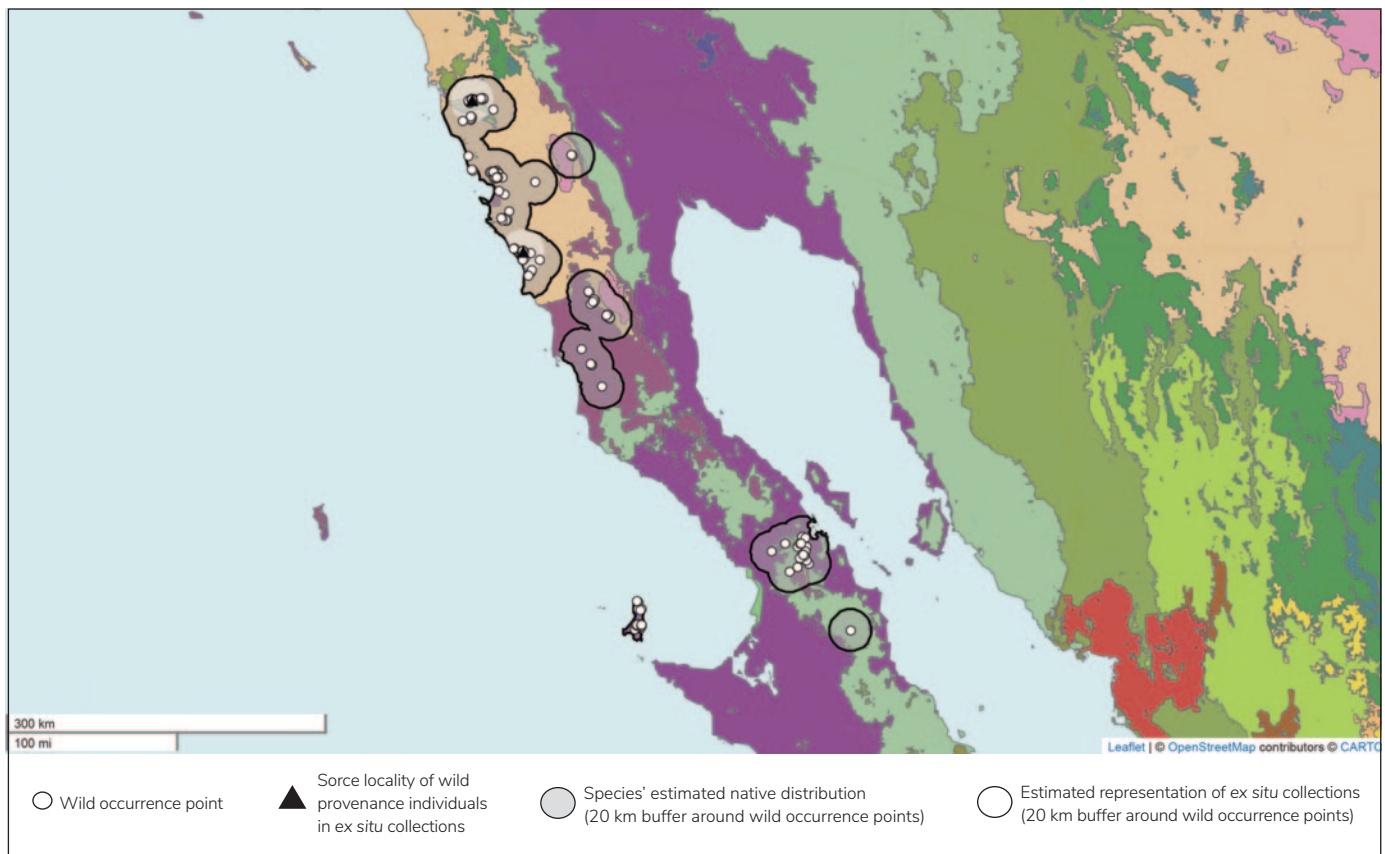
Number of ex situ collections reporting this species	2
Number of plants in ex situ collections	6
Average number of plants per institution	3
Percent of ex situ plants of wild origin	100%
Percent of wild origin plants with known locality	100%



**Figure 3.** Number and origin of *Quercus cedrosensis* plants in ex situ collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.



A spatial analysis was conducted to estimate the geographic and ecological coverage of ex situ collections using methods adapted from Khoury et al. (2020; Figure 4). Twenty-kilometer buffers were placed around each wild occurrence point as well as the source locality of each plant living in ex situ collections. Collectively, the buffer area around the wild occurrence points represents the inferred native range of the species. The buffer area around ex situ points serves as the native range represented in ex situ collections. Geographic coverage of ex situ collections was estimated by dividing the ex situ buffer area by the area of the inferred native range. Ecological coverage of ex situ collections was estimated by dividing the number of Holdridge life zones present under the ex situ buffer by the number of Holdridge life zones under the inferred native range. The species representativeness ex situ was calculated by counting the number of ex situ institutions that currently have one or more living individuals of wild provenance in their collections, up to a maximum of ten. In order to maintain a consistent scale across all scores, this number was multiplied by ten. All three scores range from 0–100. A final ex situ conservation score was calculated by taking an average of the three scores above. Final scores range from 0–100, with scores near 100 indicating comprehensive ex situ conservation, and scores near 0 indicating poor ex situ conservation (Table 2). As a reference, the threatened Mesoamerican oaks with the highest ex situ conservation scores are *Q. engelmannii* with a score of 76/100, and *Q. brandegeei* with a score of 74/100. There are 10 threatened oaks with final ex situ scores of 10 or less.



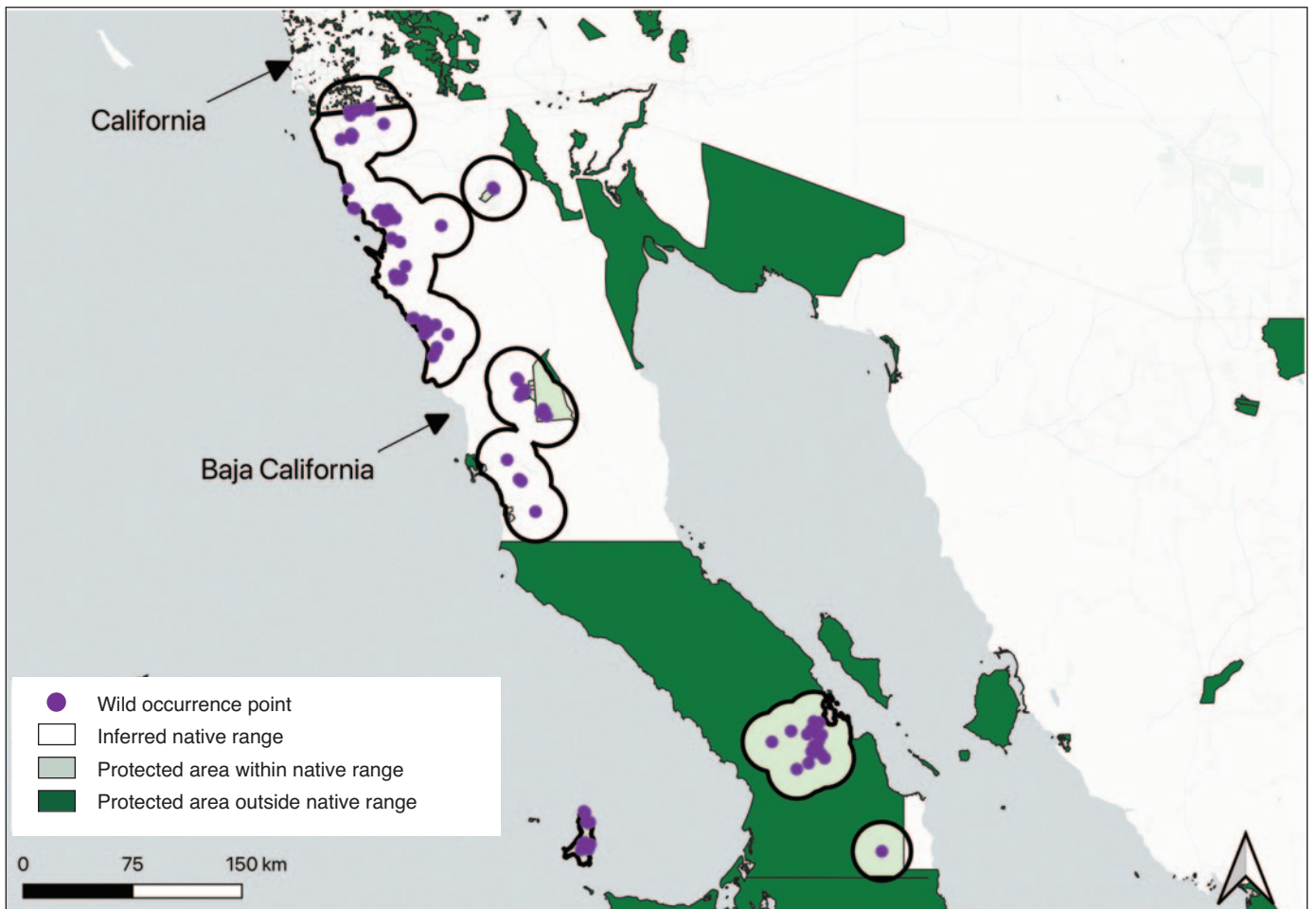
**Figure 4.** *Quercus cedrosensis* wild occurrence points and ex situ collection source localities. Colored regions are Holdridge life zones. All ex situ collection source localities are also wild occurrence points.

Using methods adapted from Khoury et al. (2020), we estimated the degree of representation of *Q. cedrosensis* in protected areas in order to identify *in situ* conservation gaps. Wild occurrence points were mapped and overlaid with protected areas from the World Database on Protected Areas (Figure 5; UNEP-WCMC and IUCN, 2023). A twenty-kilometer buffer was placed around each occurrence point to represent the species inferred native range. Geographic coverage *in situ* was estimated by calculating the proportion

**Table 2.** Ex situ conservation scores for *Quercus cedrosensis* with all scores ranging from 0–100. A final score of 100 indicates comprehensive ex situ conservation, and a score of 0 represents poor ex situ conservation.

Geographic coverage ex situ	11
Ecological coverage ex situ	63
Representation in ex situ collections	30
Final ex situ conservation score	34

of a species inferred native range that is covered by protected areas. Ecological coverage *in situ* was estimated by identifying the Holdridge life zones in the inferred native range as well as the Holdridge life zones in protected areas within the inferred native range and calculating the percentage of life zones that are conserved in protected areas. Species representativeness *in situ* was estimated by calculating the percentage of known occurrence points within the species inferred native range that fall inside protected areas. All three scores range from 0–100. A final conservation score *in situ* was calculated by taking an average of the three scores above. Final scores range from 0–100, with scores near 100 indicating comprehensive *in situ* conservation, and scores near 0 indicating poor *in situ* conservation (Table 3). As a reference, the threatened Mesoamerican oaks with the highest *in situ* conservation scores are *Q. carmenensis* with a score of 99/100, and *Q. costaricensis* with a score of 94/100. There are two threatened oaks with final *in situ* scores of 10 or less.



**Figure 5.** Wild occurrence points and inferred native range of *Quercus cedrosensis* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).

**Table 3.** *In situ* conservation scores for *Quercus cedrosensis* with all scores ranging from 0–100. A final score of 100 indicates comprehensive *in situ* conservation, and a score of 0 represents poor *in situ* conservation.

Geographic coverage <i>in situ</i>	30
Ecological coverage <i>in situ</i>	100
Species representation in <i>in situ</i> collections	38
Final <i>in situ</i> conservation score	56

**Land protection:** Within the inferred native range of *Q. cedrosensis*, 30% is within protected areas (Figure 5). Almost all protected areas are in the southern portion of the species’ range, in the Flora and Fauna Protection Area “Valle de los Cirios”, which is one of the largest protected areas in Mexico. Cedros Island is also protected as part of the Baja California Pacific Islands Biosphere Reserve (Aguirre-Muñoz and Méndez-Sánchez, 2017). There is very little protection in northern Baja California. Protected areas are typically in rural

areas, with less protection in urban areas. Although federally protected areas are more established than those designated at the state-level, they will likely not grow as easily.

**Sustainable management of land:** There is a management plan for the Valle de los Cirios protected area (CONANP, 2013). A management plan for the Baja California Pacific Islands Biosphere Reserve is being developed. It will include management activities for native vegetation on the islands, including Cedros. It is unknown if there is sustainable management of land for the populations in mainland northern Baja California, although there is so much interest in development within the area that this is not likely.

**Population monitoring and/or occurrence surveys:** In 2021, the San Diego Botanic Garden (SDBG) received a grant to re-survey occurrences of *Q. cedrosensis* in the United States. Data on distribution, acorn production, and growth have been collected (Berrini and Bluffin, 2023).

**Wild collecting and/or ex situ curation:** There has been some surveying and acorn collection for *Q. cedrosensis*, however it is not widespread. According to the results of our ex situ surveys, this species is currently held in two ex situ collections. We also know of a third collection of *Q. cedrosensis* in California that was added after our last ex situ survey, and is therefore not reflected in our results.

**Propagation and/or breeding programs:** In 2021, SDBG collected acorns from the United States population and successfully germinated four seedlings. Two each were distributed to partners at The Huntington and SDZWA, and two remained at SDBG. Seed for *Q. cedrosensis* is not readily available in the wild, and there is a need to explore alternative propagation methods to foster ex situ collections. SDZWA has had success with air layering this species in the Otay Mountain Wilderness. It has been reported to be a slow process relative to more typically air layered species; root growth occurred after approximately 19 months (Berrini and Bluffin, 2023). The first seedling resulting from air layering was planted at SDZWA in February 2024, and a second air layer was harvested in April 2024 in the Otay Mountain Wilderness. The SDZWA has also been successful rooting cuttings of *Q. cedrosensis*, with four cuttings of two maternal lines as of 2024. In-vitro germination and tissue culture is also being explored for this species.

**Reintroduction, reinforcement, and/or translocation:** This is not a conservation activity at the time of publication.

**Research:** There is relatively little research focused on *Q. cedrosensis*. A recent study looked at the impact of climate change on the distribution of *Q. cedrosensis*, along with other



species (Ramírez-Preciado et al., 2019). In 2015, the Las Californias Binational Conservation Initiative published a review on the conservation gains and habitat losses of the US-Mexico border region between California and Baja California (Stallcup et al., 2015). While not focused on *Q. cedrosensis* specifically, the review proposes strategies for land management and protection within *Q. cedrosensis*' habitat. A 2022 paper by Rosenberger et al. aimed to establish minimum sampling sizes necessary to capture genetic diversity in ex situ collections, and included *Q. cedrosensis* as a target species. Their results showed that the minimum sampling size for this species exceeds 500 individuals, most likely due to its relatively large population size.

**Education, outreach, and/or training:** Education is occurring at the university level, but it is not widespread in the region or the community.

**Species protection policies:** There are no national or statewide protection policies in place for this species.

## PRIORITY CONSERVATION ACTIONS

In order to conserve *Q. cedrosensis*, the conservation activities that should be given the highest priority are:

### Population monitoring and/or occurrence surveys

More work is needed to survey this species in Mexico and determine its accurate distribution. Identifying potential habitat to direct future field work should also be a priority.

### Land protection

Very little of this species' range is protected in northern Baja California. This area is under imminent threat from land use changes, specifically urban and rural development.

### Wild collecting and/or ex situ curation

There is a need for ex situ collections from Cedros Island

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