

Conservation Gap Analysis of Native Mesoamerican Oaks



Béatrice Chassé

Species profile: *Quercus tomentella*

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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



Quercus tomentella Engelm.

Common Names, English: Island Oak

IUCN Red List Status: Endangered: B2ab(i,ii,iv,v)

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DISTRIBUTION AND BIOLOGY

Quercus tomentella is a rare species of oak that is restricted to the Channel Islands (Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, and San Clemente) off the coast of California, and Guadalupe Island, Mexico (Figure 1). Fossil evidence suggests that *Q. tomentella* once had a much wider distribution throughout mainland California, and became confined to islands only when the mainland climate

became less temperate (Muller, 1965). First described by Jepson (1910) on Guadalupe Island, *Q. tomentella* is named for the tomentose hairs on the underside of its leaves. This species belongs to the rare section *Protobalanus* (intermediate, or golden-oaks), a small clade of only five species. On the mainland, *Q. tomentella* is found at elevations of 100–650 m asl on ridge tops and canyons in areas with frequent fog (Beckman et al., 2019). On Guadalupe Island, several individuals are found at elevations above 1,150 m, with most occurring between 700 and 800 m asl. A majority of occurrences are in the warm temperate thorn scrub life zone (Figure 2).

Quercus tomentella can reach heights up to 20 meters, but the harsh island conditions result in many individuals being shrunken and wind-shaped (Beckman and Jerome, 2017). Leaves are dark green, oblong to oblong-ovate, with crenate to dentate (rarely entire) margins. Acorns take two years to mature.



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

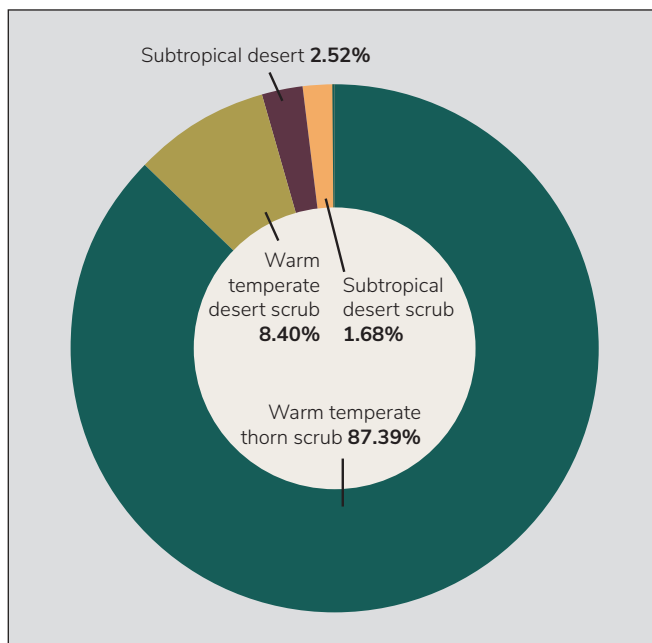


Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus tomentella* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: This is not a current threat on Guadalupe Island. Since 2005 the island has been a protected area, and only research, conservation and restoration activities are allowed.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: This is not a current threat on Guadalupe Island.

Human use of landscape — residential/commercial development, mining, and/or roads: This is not a current threat on Guadalupe Island.

Human use of landscape — tourism and/or recreation: This is not a current threat on Guadalupe Island. Tourism on this island is currently not allowed.

Human modification of natural systems — altered fire regime, pollution, eradication: Feral goats were present on Guadalupe Island for more than 100 years, modifying the vegetation communities and causing soil erosion. Feral goats were removed but the damage was very extensive so active conservation and restoration actions are being implemented to restore the *Q. tomentella* population and to protect the current remnant population (i.e., decrease fire risk).

Human modification of natural systems — invasive species competition/disturbance: There is no evidence of competition with invasive species on Guadalupe Island, however little research has been done on this subject.

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Habitat shifting, drought, temperature extremes, and/or flooding threaten *Q. tomentella* on Guadalupe Island. In addition, changes in fire regime and a potential proliferation of pests and/or pathogens as a result of climate change could be a threat in the future. Within the inferred native range of *Q. tomentella*, the warm temperate thorn scrub is expected to decrease in area by an average of 32% by the years 2061–2080 relative to current conditions (Good et al., 2024).

Genetic material loss — inbreeding and/or introgression: On Guadalupe Island, *Q. tomentella* is the only oak species so there is no risk of hybridization. However, some of the remaining adults are isolated from one another so there is potential inbreeding. Hybrids with *Q. chrysolepis* are known from the California islands and have occurred in cultivation.

Pests and/or pathogens: Unknown. This could potentially be an issue, but has not been studied. This is an area for potential research on Guadalupe island.

Extremely small and/or restricted population: In Mexico, *Q. tomentella* is only found in Guadalupe island.

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. tomentella* (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.

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

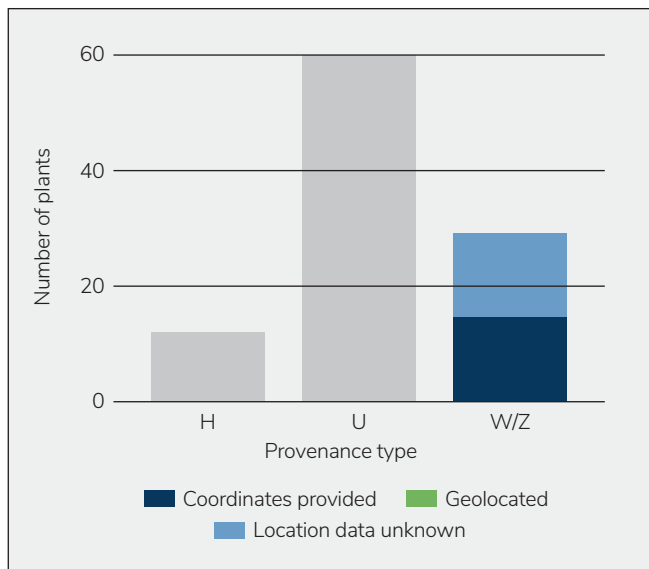


Figure 3. Number and origin of *Quercus tomentella* plants in ex situ collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

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

Number of ex situ collections reporting this species	28
Number of plants in ex situ collections	99
Average number of plants per institution	4
Percent of ex situ plants of wild origin	28%
Percent of wild origin plants with known locality	46%

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.

Using methods adapted from Khoury et al. (2020), we estimated the degree of representation of *Q. tomentella* 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 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.

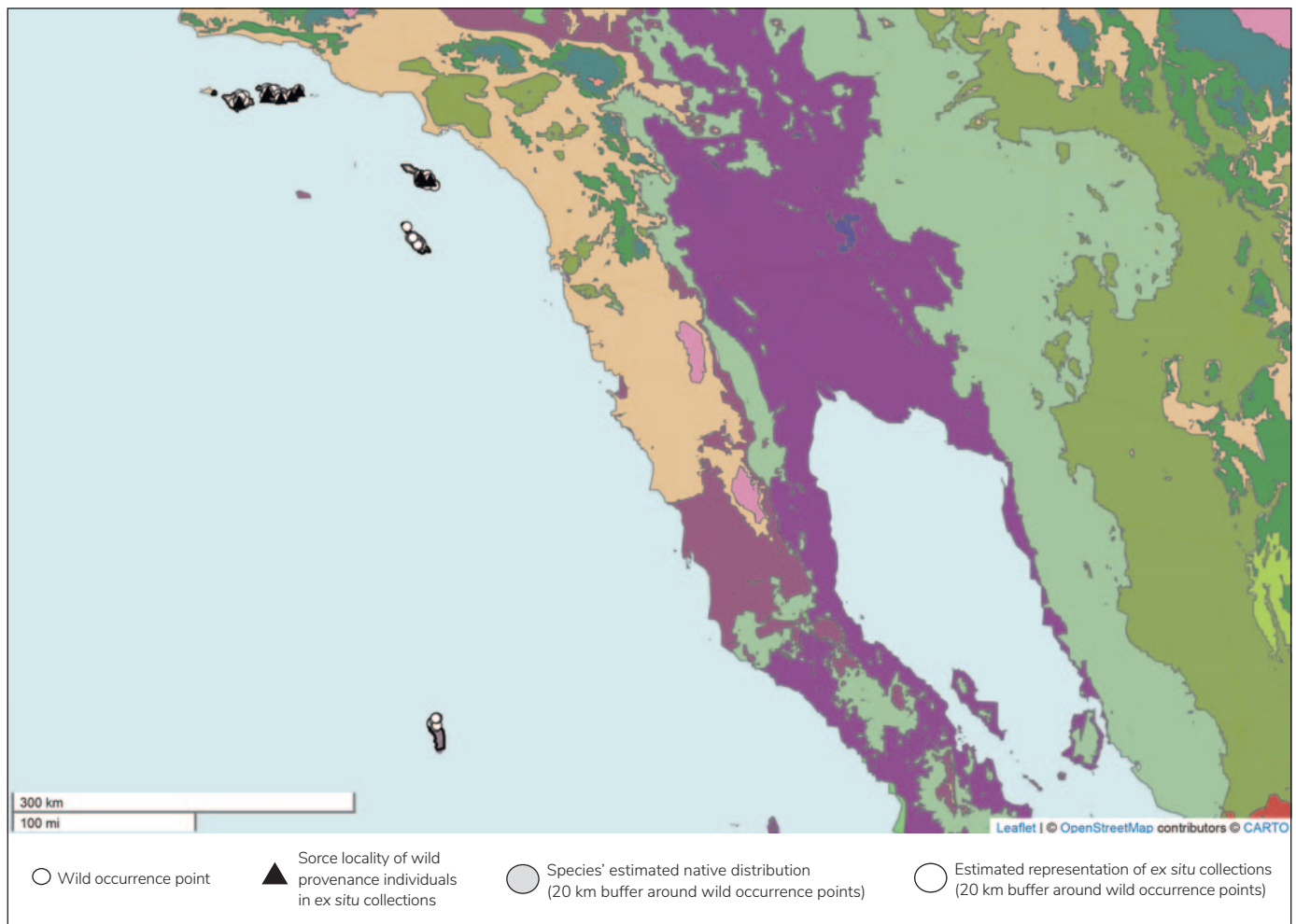


Figure 4. *Quercus tomentella* wild occurrence points and ex situ collection source localities. Colored regions are Holdridge life zones. All ex situ collection source localities are also wild occurrence points.

Table 2. Ex situ conservation scores for *Quercus tomentella* 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	63
Ecological coverage ex situ	20
Representation in ex situ collections	100
Final ex situ conservation score	61



Béatrice Chassé

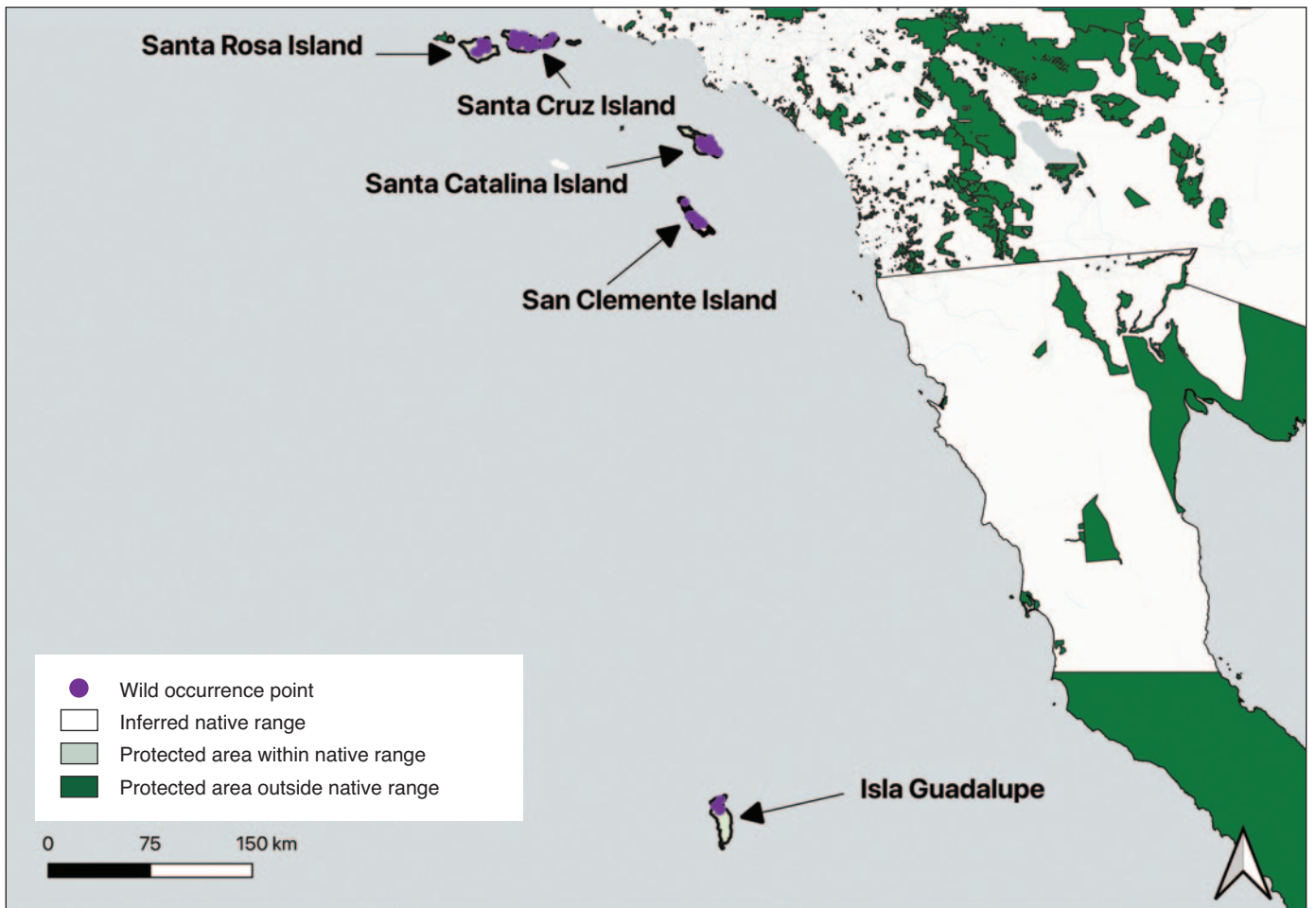


Figure 5. Wild occurrence points and inferred native range of *Quercus tomentella* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).

Table 3. *In situ* conservation scores for *Quercus tomentella* 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>	84
Ecological coverage <i>in situ</i>	100
Species representation in <i>in situ</i> collections	84
Final <i>in situ</i> conservation score	89



Béatrice Chassé

Land protection: Within the inferred native range of *Q. tomentella* in Mexico, 100% is within a protected area (Figure 5). The entirety of the population in Mexico is on Guadalupe Island, which is designated as a Biosphere Reserve.

Sustainable management of land: There is management in place to reduce and remove fire hazards.

Population monitoring and/or occurrence surveys: There is a database with the geographic location of each known adult for Guadalupe Island as well as the reforested areas. The survival of the reforested individuals is closely monitored.

Wild collecting and/or ex situ curation: According to the results of our ex situ survives, *Q. tomentella* is held in 28 ex situ collections, eight of which have individuals of wild provenance. There are unverified reports of 4–5 individuals from Guadalupe Island at two university campuses in Mexico. However, these were not included in our ex situ surveys. There are no ex situ collections from the Mexican population of this species.

Propagation and/or breeding programs: There is a nursery on Guadalupe Island that reproduces *Q. tomentella* and other native plants. They do observational studies to estimate flower production and fruit production. Currently there are 50 mature adults on the island.

Reintroduction, reinforcement, and/or translocation: A recent project funded by the Franklinia Foundation, in combination with resources from Mexican Agencies such as CONAFOR (Comisión Nacional Forestal) and CONANP (Comisión Nacional de Áreas Naturales Protegidas), have planted seedlings of three endangered trees on Guadalupe Island: *Pinus radiata*, *Cupressus guadalupensis* and *Quercus tomentella*. Since 2017, 6,000 oak seedlings have been reforested.

Research: A recent study looked at micro adaptation of oaks in regards to climate change and includes *Q. tomentella* as a study species (Mead, 2023). There is also research on the genetic structure and variation of *Q. tomentella* (Ashley et al. 2016; 2018).

Education, outreach, and/or training: There is a fishing community on the island of approximately 100–150 people. They have learned about oaks and other unique plants from the island.

Species protection policies: This is not a current conservation activity. This species is proposed to be included in the NOM-059.

PRIORITY CONSERVATION ACTIONS

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

Propagation and/or breeding programs

Not all mature individuals are producing acorns, so it is especially important to explore new methods for vegetative propagation, such as air layering.

Wild collecting and/or ex situ curation

There are currently no ex situ collections from Guadalupe Island. This is in part due to the long process to obtain collecting permits in Mexico. Permits need to be granted from several Federal Mexican agencies, which can take some time.

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