Conservation Gap Analysis of Native

Mesoamerican Oaks


Emily Griswold

Species profile: ***Quercus ajoensis***

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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

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Global Conservation Consortium Oak

CSS TREES Center for Species Survival

Franklinia Foundation

Quercus ajoensis C.H.Müll.

Synonyms: *Quercus turbinella* subsp. *ajoensis*, *Quercus turbinella* var. *ajoensis*
Common Names, English: Ajo Mountain Scrub Oak
IUCN Red List Category and Criteria: Vulnerable B2ab(iii)

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DISTRIBUTION AND BIOLOGY

Quercus ajoensis, or Ajo Mountain Scrub Oak, is known from a small number of isolated populations in southwestern Arizona where it is restricted to three canyons in the Ajo Mountains (Wiens and Thibault, 2019). In Mexico, *Q. ajoensis* has been recorded from three regions in Baja California Sur: Sierra San Francisco to the West, Volcán las Tres Vírgenes to the East, and San Jerónimo to the South (Figure 1). The most recent record in Mexico is a 2002 collection near San Jerónimo. The remaining collections are from the 1960's and 1970's. A detailed analysis suggests that the Baja individuals are of hybrid populations. The Sierra San Francisco population could be treated as *Q. ajoensis* x *oblongifolia*, and the Volcán las Tres Vírgenes and San Jerónimo populations, despite having several characteristics typical for *Q. ajoensis*, are not part of pure populations and should be considered as a hybrid of *Q. ajoensis*. The San Jeróronimo population may be a new species, and this is currently being investigated. It is likely that previous interactions of *Q. ajoensis* and *Q. turbinella* have formed hybrid populations that could be treated as *Q. ajoensis* x *turbinella*. It is very probable that this species is distributed in northern Sonora, as some isolated sierras of northern Sonora have environmental conditions that are suitable for this species (Tucker and Muller, 1956). However, no occurrence data for this region is available and it is necessary to carry out field work to verify its presence within Sonora.

Quercus ajoensis is an evergreen shrub that can reach up to 2–3 m in height. It occurs on volcanic slopes between 500 and 1,500 m above sea level within two Holdridge life zones: subtropical thorn woodland and subtropical desert scrub (Figure 2). In the Ajo mountains, *Q. ajoensis* can be found in canyon bottoms, on grassy slopes, and at the bases of north-facing canyon walls where it grows in association with grasses and junipers (Tucker and Muller, 1956).

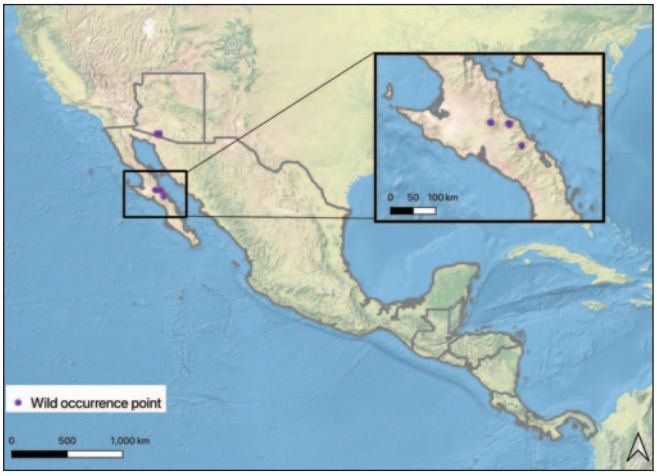

Figure 1. Wild (i.e., *in situ*) occurrence points for *Quercus ajoensis*.

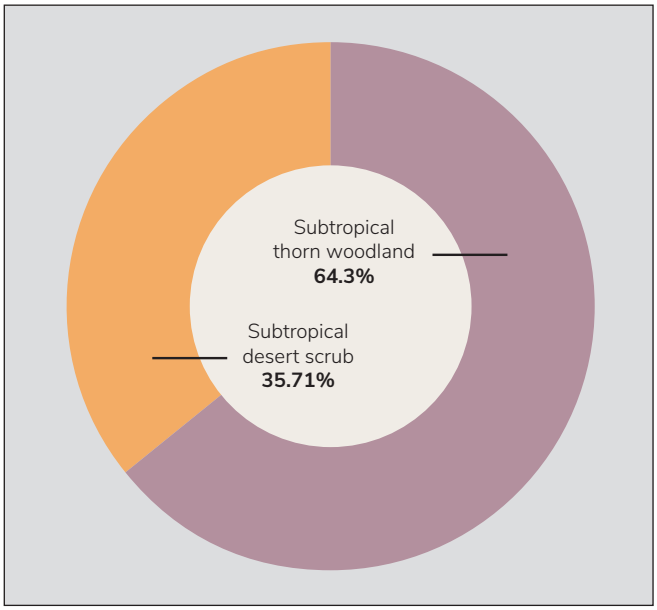

Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus ajoensis* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: Unknown.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: Fence breaks associated with border patrol activities have allowed cattle, horses, and burros into Organ Pipe Cactus National Monument, impacting *Q. ajoensis* within this protected area (National Park Service, 2013). This is considered a low impact threat (Beckman et al., 2019).

Human use of landscape — residential/commercial development, mining, and/or roads: This is not a major threat at the time of publication.

Human use of landscape — tourism and/or recreation: The largest subpopulation of *Q. ajoensis* is located within Organ Pipe Cactus National Monument which is near the U.S.-Mexico border. Although recreation is minimal here, the habitat is impacted by border patrol activities (including the construction of barriers without consideration of federal, state or local environmental laws) and illegal immigration (Beckman et al., 2019). In 2010, over 2,000 miles of new roads were constructed within the region (Peterson, 2014). In Baja California, hiking is practiced on the Las Tres Vírgenes volcano, although it is minimal.

Human modification of natural systems — altered fire regime, pollution, eradication: In southern Arizona, altered fire regimes have resulted in less frequent, but more severe fires. Non-native grass invasions are a primary driver of altered fire regimes in desert shrublands within the region (Wilder et al., 2021). The invasive species buffelgrass (*Cenchrus ciliaris*) is especially problematic.

Human modification of natural systems — invasive species competition/disturbance: Unknown. Buffelgrass threatens native species in southern Arizona, although direct effects on oaks have not been observed.

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: *Quercus ajoensis* is especially susceptible to desiccation, and drought has been cited as a controlling factor in the distribution of this species (Tucker and Muller, 1956). In Baja California Sur, increasing temperature and decreasing precipitation are considered to be the main threats. Within the inferred native range of *Q. ajoensis*, the subtropical thorn woodland is expected to decrease in area by an average of 18% by the years 2061–2080 relative to current conditions (Good et al., 2024).

Genetic material loss — inbreeding and/or introgression: *Quercus ajoensis* hybridizes with *Q. turbinella* and *Q. oblongifolia*.

Pests and/or pathogens: Unknown.

Extremely small and/or restricted population: *Quercus ajoensis* is very rare within the landscape. It has a very small distribution area in both Arizona and Baja California. A severe fire within the region could wipe out an entire population.

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. ajoensis* (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	9
Number of plants in ex *situ* collections	87
Average number of plants per institution	10
Percent of ex *situ* plants of wild origin	83%
Percent of wild origin plants with known locality	86%

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

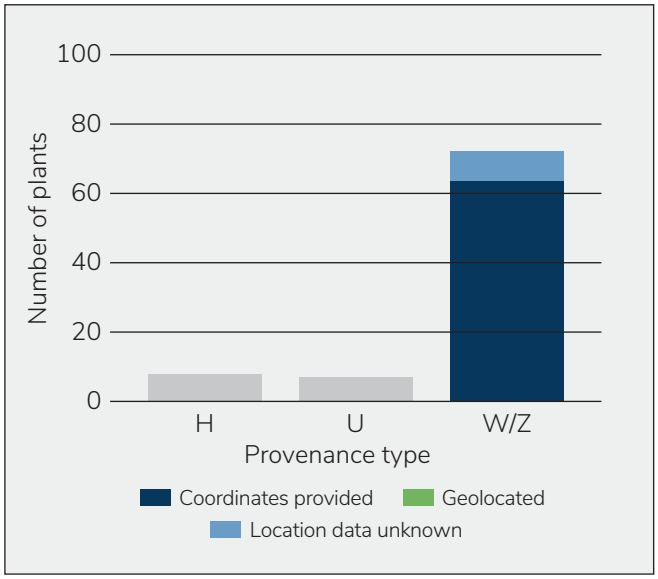

Figure 3. Number and origin of *Quercus ajoensis* plants in ex *situ* collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

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.

Table 2. Ex *situ* conservation scores for *Quercus ajoensis* 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*	31
Ecological coverage ex *situ*	40
Representation in ex *situ* collections	60
Final ex *situ* conservation score	44

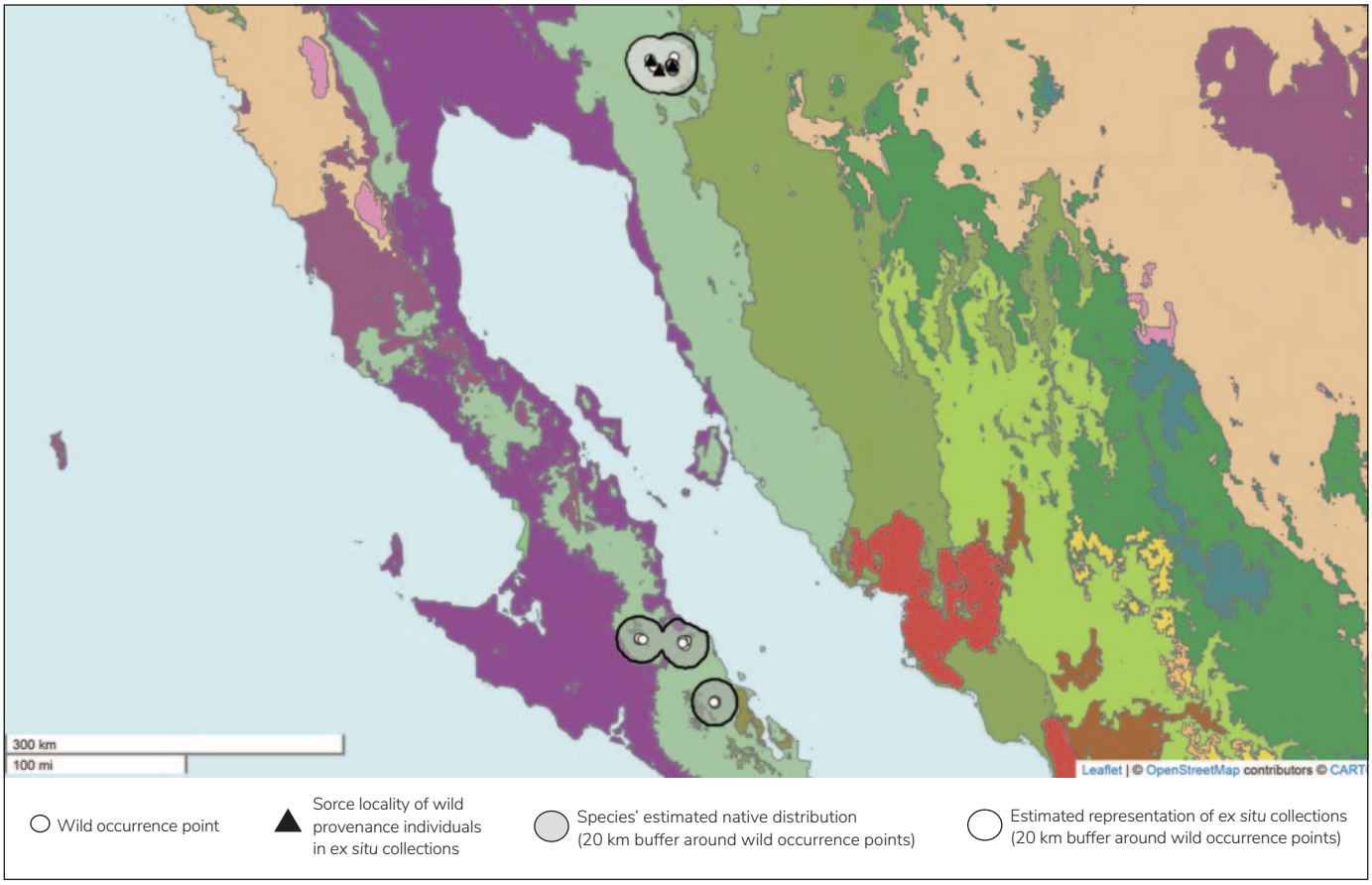

Figure 4. *Quercus ajoensis* wild occurrence points and *ex situ* collection source localities. Colored regions are Holdridge life zones. All *ex situ* collection source localities are also wild occurrence points.

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

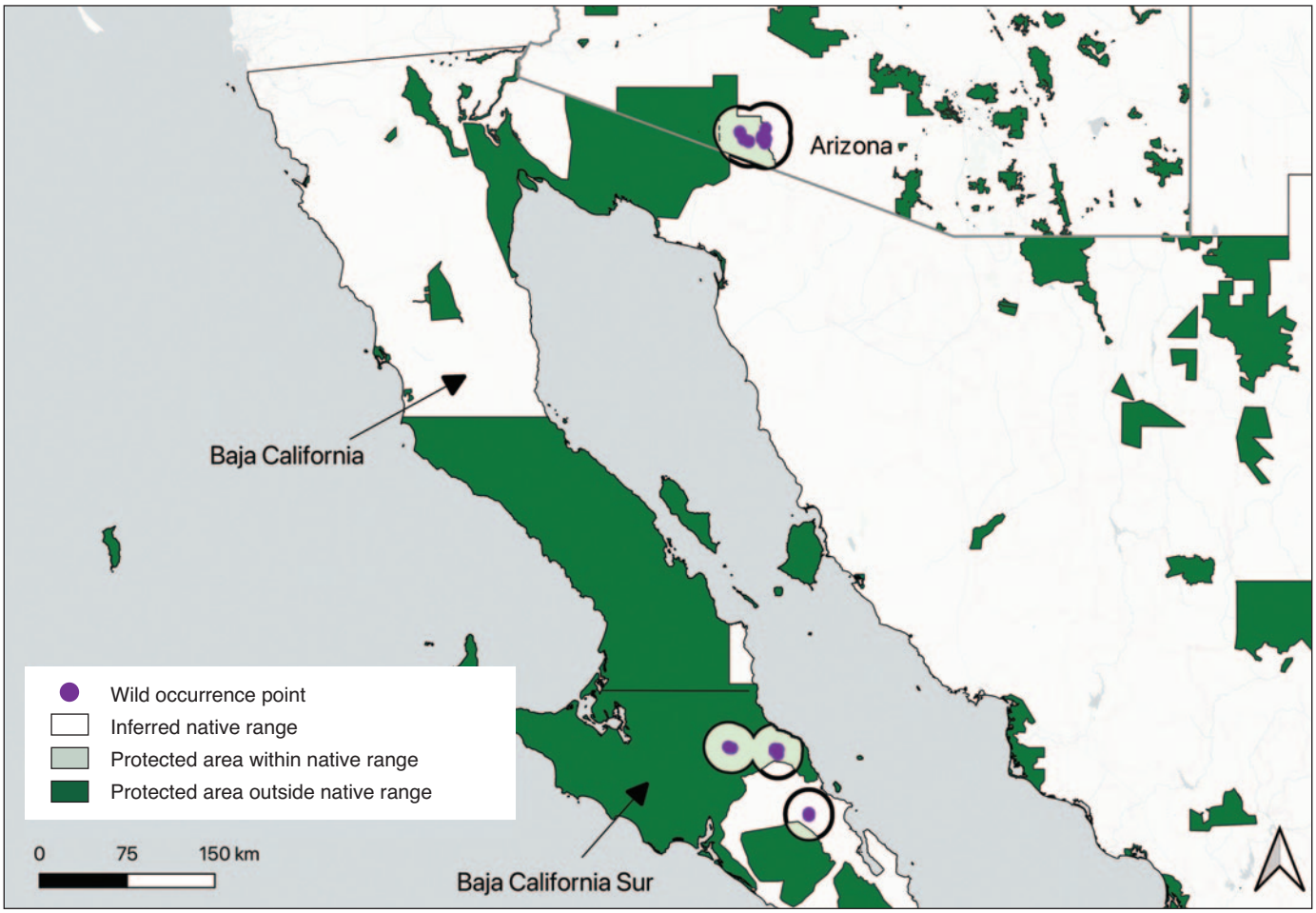

Figure 5. Wild occurrence points and inferred native range of *Quercus ajoensis* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).

Table 3. *In situ* conservation scores for *Quercus ajoensis* 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 *in situ*	63
Ecological coverage *in situ*	80
Species representation in *in situ* collections	83
Final *in situ* conservation score	75

Land protection: Within the inferred native range of Q. ajoensis, 63% is within protected areas (Figure 5). Significant protected areas include El Vizcaíno, a Biosphere Reserve in Baja California Sur and Organ Pipe Cactus National Monument in Arizona, United States.

Sustainable management of land: There is sustainable management of Organ Pipe National Monument in Arizona. It is unknown if there is land management within the native range of *Q. ajoensis* in Baja California Sur.

Population monitoring and/or occurrence surveys: There have been occurrence surveys for *Q. ajoensis* in the Ajo Mountains led by The Huntington in collaboration with Arizona-Sonora Desert Museum (Wiens and Thibault, 2019). In Mexico, recent explorations (November 2023) to plant communities up to approximately 1200 meters above sea level in the El Azufre volcano and in those adjacent to the Las Tres Vírgenes volcano found no individuals that were recognized as *Q. ajoensis*. This suggests that populations in this region are distributed at the upper end of their altitudinal range, starting at 1400 m, as indicated on some herbarium specimens. There is additional survey work planned for *Q. ajoensis* within Baja California in late 2024 as a collaboration between researchers in the United States and Mexico.


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Wild collecting and/or ex situ curation: According to the results of our ex situ surveys, *Q. ajoensis* is currently held in nine *ex situ* collections, six of which have individuals of wild provenance. There are no collections from Mexico.

Propagation and/or breeding programs: Germplasm gathered during expeditions to the Ajo Mountains is being grown in botanic gardens in the United States (Beckman et al., 2019). This is not a known conservation activity in Mexico.

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

Research: There is little to no research focused on *Q. ajoensis*.

Education, outreach, and/or training: This is not a known conservation activity at the time of publication.

Species protection policies: This is not a known conservation activity at the time of publication.

PRIORITY CONSERVATION ACTIONS

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

Population monitoring and/or occurrence surveys

More exploration and collection is necessary to identify previously recorded occurrence points within Mexico. Potential habitat within Sonora should also be explored.

Propagation and/or breeding programs

Genetic studies and research focusing on taxonomy/phylogenetics is necessary to determine the true status of this species in Mexico.

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