

Conservation Gap Analysis of Native Mesoamerican Oaks



Species profile: *Quercus graciliformis*

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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 graciliformis C.H.Müll.

Common name(s), English: Chisos Oak, Graceful Oak, Slender Oak

IUCN Red List Category and Criteria: Endangered C2a(ii)

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DISTRIBUTION AND BIOLOGY

Quercus graciliformis is found within an extremely limited range in the Chisos Mountains, western Texas (Figure 1). There are also unverified reports of *Q. graciliformis* in Mexico. More survey work is needed in the Mexican states of Coahuila and Chihuahua since suitable habitat is available here and there have been no extensive searches within this region. *Quercus graciliformis* is very closely related to *Q. canbyi*, which can be found in the Sierra Madre Oriental in the Mexican state of Nuevo León (Muller, 1940). It is difficult to distinguish the two species in the field, and it is likely that the occurrences we have mapped in Nuevo León are actually *Q. canbyi*. *Quercus canbyi* is an annual species, and *Q. graciliformis* is biennial. The few specimens that have recently been observed in Nuevo León are *Q. canbyi*, and it is believed that *Q. graciliformis* is unlikely to grow here (Allen Coombes, personal communication, 2024). More work is needed to determine the true distribution of this species.

Quercus graciliformis is a small tree, growing up to 8 m tall. It has slender, arching branches and narrow, glossy leaves. It has a very specialized habitat, growing in dry oak woodlands along the banks of arroyos in areas with a high water table (Jerome et al., 2017). In Texas, a majority of occurrences are within the warm temperate thorn scrub life zone. The occurrences in Mexico are primarily within the subtropical dry forest life zone (Figure 2).



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



Michael Eason

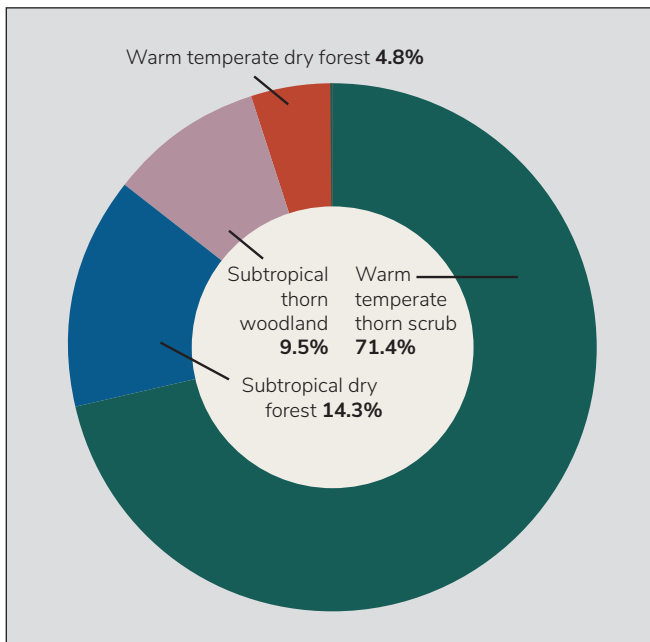


Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus graciliformis* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: Unknown.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: This is not considered a threat at the time of publication.

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

Human use of landscape — tourism and/or recreation: In the United States, recreational activities within Big Bend National Park are a threat. The Blue Creek Canyon trail cuts through *Q. graciliformis* habitat in the national park (Beckman, 2017). However, this is not likely to seriously harm the species and it is not considered a major threat at the time of publication.

Human modification of natural systems — altered fire regime, pollution, eradication: This is not considered a threat at the time of publication.

Human modification of natural systems — invasive species competition/disturbance: This is not considered a threat at the time of publication.

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Wildfire resulting from a warmer, drier climate is a major threat to *Q. graciliformis*. This species inhabits one relatively narrow canyon, where fire could do extensive damage (Beckman, 2017). Within the inferred native range of *Q. graciliformis*, the warm temperate thorn scrub is expected to decrease in area by an average of 78% by the years 2061–2080 relative to current conditions (Good et al., 2024).

Genetic material loss — inbreeding and/or introgression: While there have been reports of *Q. graciliformis* hybridizing with *Q. emoryi* where their ranges overlap in Texas, this is not currently considered a major threat (Southwest Desert Flora, 2019).

Pests and/or pathogens: Unknown.

Extremely small and/or restricted population: *Q. graciliformis* is known to occur in a single narrow canyon within Texas. More survey work is needed to determine if this species also occurs over the border in Coahuila or Chihuahua, Mexico. As it currently stands, this is considered the primary threat facing this species.



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. graciliformis* (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

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

Number of ex situ collections reporting this species	24
Number of plants in ex situ collections	189
Average number of plants per institution	8
Percent of ex situ plants of wild origin	39%
Percent of wild origin plants with known locality	24%

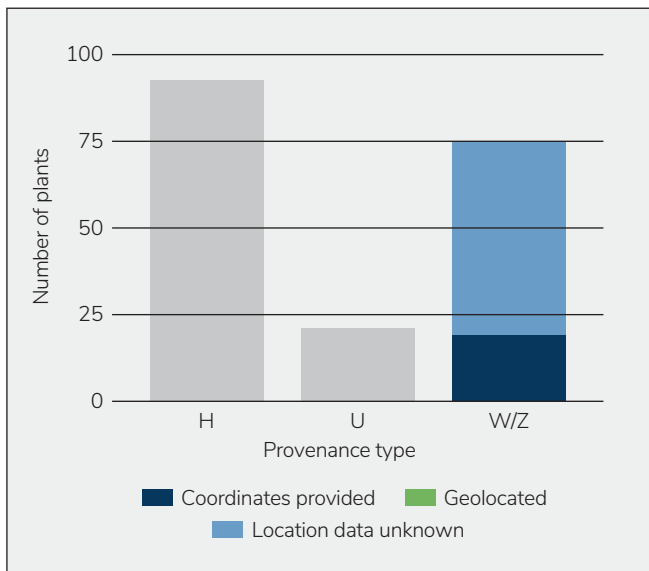


Figure 3. Number and origin of *Quercus graciliformis* plants in ex situ collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

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.



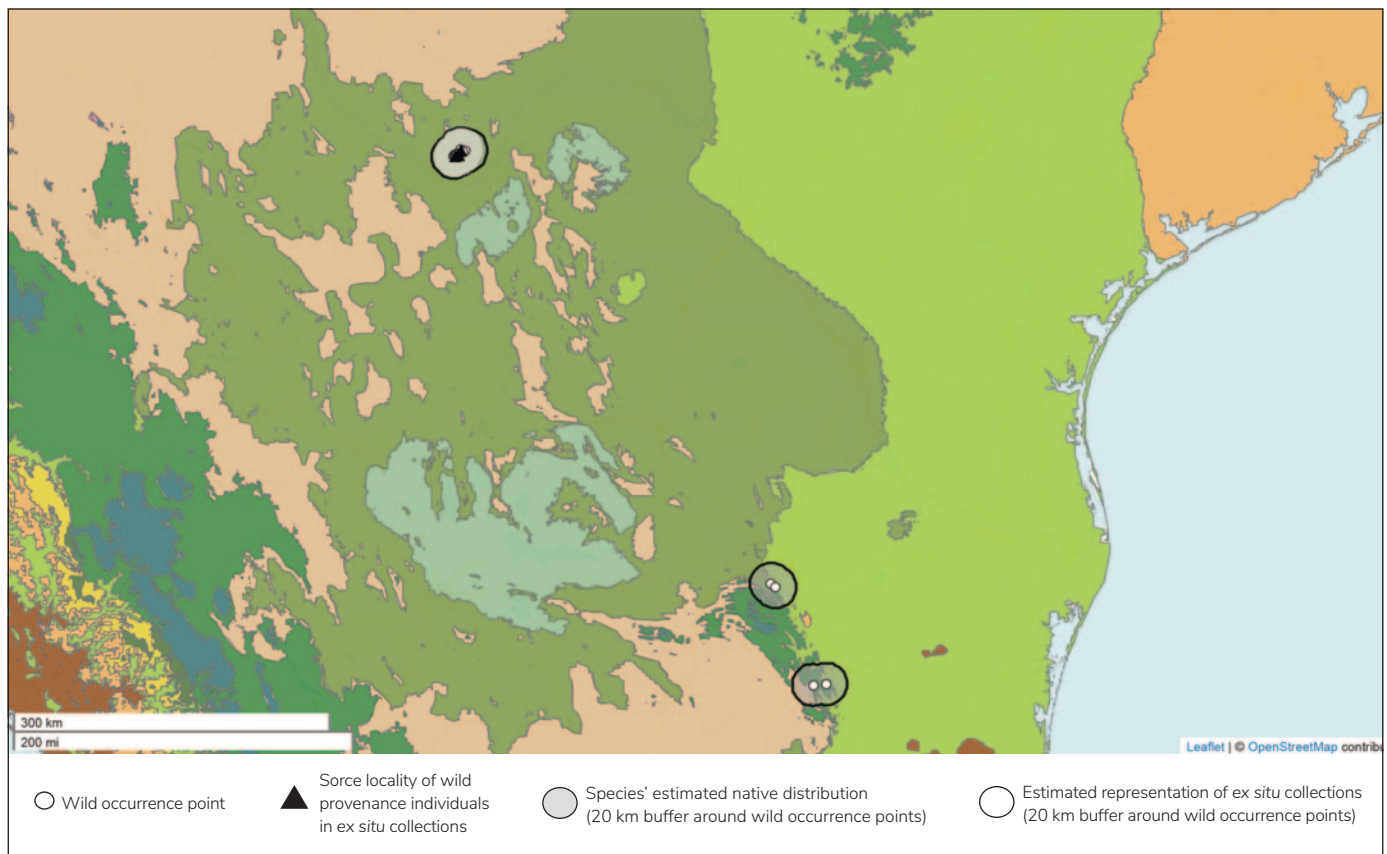


Figure 4. *Quercus graciliformis* wild occurrence points and ex situ collection source localities. Colored regions are Holdridge life zones. All ex situ collection source localities are also wild occurrence points.

Table 2. Ex situ conservation scores for *Quercus graciliformis* 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	33
Ecological coverage ex situ	50
Representation in ex situ collections	80
Final ex situ conservation score	54

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

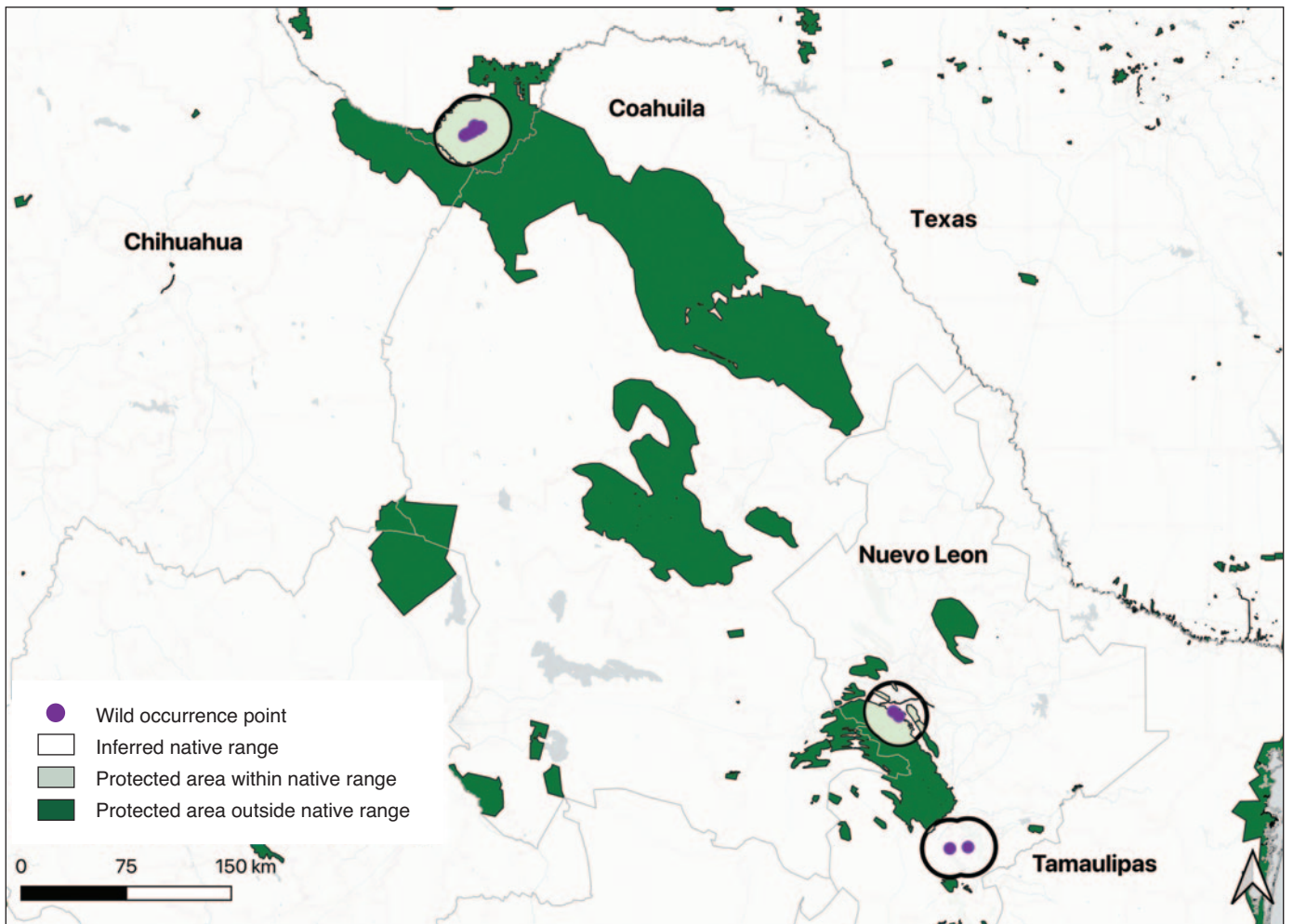


Figure 5. Wild occurrence points and inferred native range of *Quercus graciliformis* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).



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Table 3. *In situ* conservation scores for *Quercus graciliformis* 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>	51
Ecological coverage <i>in situ</i>	100
Species representation in <i>in situ</i> collections	85
Final <i>in situ</i> conservation score	78

Land protection: In the United States, this species occurs within Big Bend National Park. In Mexico, we have mapped occurrences in Cumbres de Monterrey National Park in Nuevo León. However, it is possible this more accurately describes the distribution of *Q. canbyi*. More work is needed here.

Sustainable management of land: There is a management plan for Big Bend National Park, which includes restoration of native plants and protection of genetic diversity (National Park Service, 2004). There is also a fire management plan for the park.

Population monitoring and/or occurrence surveys: In 2016 and 2018, UC Davis Arboretum & Public Garden visited the type locality of *Q. graciliformis*. During a 2024 collecting trip to Big Bend National Park, San Antonio Botanical Garden and partners identified new localities of *Q. graciliformis* with plans to revisit and collect material at a later date.

Wild collecting and/or ex situ curation: According to the results of our *ex situ* surveys, this species is currently held in 24 collections, eight of which hold individuals of wild provenance (all from Texas). During a 2024 trip to Big Bend National Park, herbarium specimens, leaf material, and scions were collected from 15 individuals. Participants included San Antonio Botanical Garden, Bartlett Tree Research Laboratories and Arboretum, Sul Ross State University, Stephen's Lake Park Arboretum, Lady Bird Johnson Wildflower Center, and NewLeaf TX.

Propagation and/or breeding programs: Acorns from collecting trips in 2016 and 2017 have been distributed for propagation to several gardens in the United States for planting within *ex situ* collections (Beckman et al., 2017).

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

Research: There is very little research focusing on *Q. graciliformis*. 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. graciliformis* as a target species. Their results showed that the minimum sampling size for this species ranged from 134–239 individuals, depending on the parameters used in the simulations. A 2016 master's thesis by A. Brennan investigated the use of different media formulations for *in vitro* tissue culture for twelve threatened oaks, including *Q. graciliformis*.

Education, outreach, and/or training: Unknown.

Species protection policies: There are no species protection policies for *Q. graciliformis* in Mexico. In the United States, this species is included in the list of the Species of Greatest Conservation Need (SGCN) in Texas, and is part of the Texas Parks and Wildlife Department's Texas Conservation Action Plan (Texas Parks and Wildlife Department, n.d.).

PRIORITY CONSERVATION ACTIONS

In order to conserve *Q. graciliformis*, the conservation activity that should be given the highest priority is:

Population monitoring and/or occurrence surveys

More exploration is needed, especially in the Mexican states of Chihuahua and Coahuila. In Texas, a majority of occurrences are within the warm temperate thorn scrub life zone. This life zone also occurs in Maderas del Carmen in Coahuila and just east of the municipality El Oasis in Chihuahua. The Nuevo León occurrences should also be explored further to determine if they are in fact *Q. graciliformis* or *Q. canbyi*.



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