Conservation Gap Analysis of Native

Mesoamerican Oaks


Luz María González-Villarreal

Species profile: ***Quercus tuitensis***

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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 tuitensis L.M.González

IUCN Red List Category and Criteria: Vulnerable D2

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DISTRIBUTION AND BIOLOGY

Quercus tuitensis is endemic to Jalisco, Mexico (Figure 1). Originally described by Luz María González-Villarreal in 2003, it inhabits a small region in the Sierra El Tuito on the northwest slope of the Sierra Madre del Sur. Its distribution is extremely localized. It is common between km 12 and km 30 along the road from the Puerto Vallarta-El Tuito highway and the Zimapán Mine. It is found at an elevation of 980–1,400 m in oak or oak-pine forests on uplands throughout barrancas. A majority of occurrences are within the subtropical moist forest life zone (Figure 2). Along with *Q. liebmannii* and *Q. glaucescens*, *Q. tuitensis* is a characteristic species of the transition zone between the oak forest and tropical deciduous forest where it tolerates dry conditions (Arenas-Navarro et al., 2020). It is also associated with species such as *Pinus oocarpa*, *Q. aristata*, *Agarista mexicana* var. *mexicana*, *Befaria mexicana*, *Clethra rosei*, *Podocarpus matudae* subsp. *jaliscanus*, and *Populus guzmanantlensis*. It is possible that *Q. tuitensis* has a wider distribution and also inhabits other areas of the Sierra El Tuito. This should be a focal region for future botanical surveys. (González-Villarreal, 2003)

Quercus tuitensis is a small to moderate-sized deciduous tree, reaching up to 8–10 m(–15 m) high with a trunk of 25–30(–60) cm diameter. The leaves of *Q. tuitensis* are light green and shiny, essentially glabrous, and are variable in shape and size. The acorns are elongate-ovoid and are paired or in clusters of 2–4. Acorns are 5–15 mm long and 5–10 mm thick. (González-Villarreal, 2003)

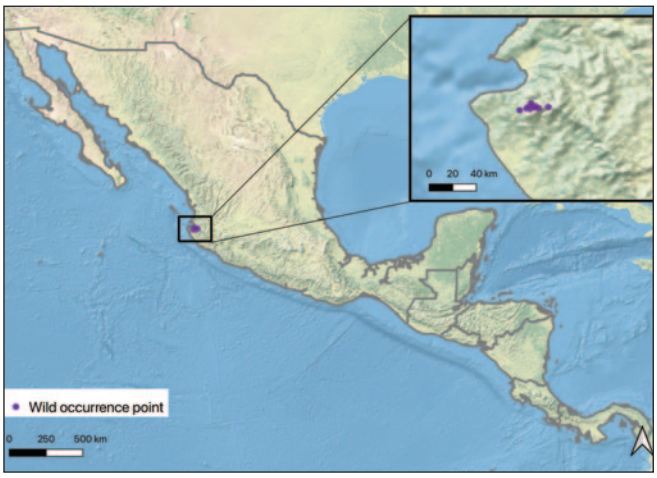

Figure 1. Wild (i.e., *in situ*) occurrence points for *Quercus tuitensis*.

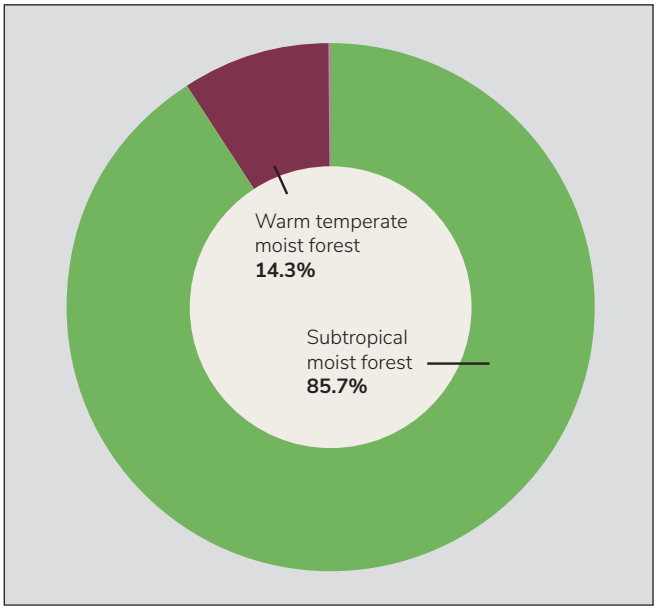

Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus tuitensis* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: Unknown.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: Livestock grazing and illegal pine logging occur within the habitat of *Q. tuitensis*.

Human use of landscape — residential/commercial development, mining, and/or roads: Copper, zinc, gold, and silver were mined from the Sierra Madre del Sur for 20 years, between 1963 and 1983 (González-Villarreal, 2003). *Quercus tuitensis* grows near the popular tourism destination of Puerto Vallarta, which is experiencing population growth. Between 2010 and 2022, the population of Puerto Vallarta increased by 14.1% (Gobierno de México, n.d.).

Human use of landscape — tourism and/or recreation: The Sierra de Cuale is experiencing increased urbanization, primarily due to tourism.

Human modification of natural systems — altered fire regime, pollution, and/or eradication: The Vallarta Botanical Garden surveyed the Sierra Cuale region in 2022 where they witnessed significant degradation of the habitat due to arson. During the dry season of 2023, this region experienced one of the worst fire seasons in recent history. Fires occurred primarily in the mountain ranges of western Jalisco, destroying large areas where this species is distributed.

Human modification of natural systems — invasive species competition: Unknown.

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: An increase in extreme weather events associated with climate change poses a major threat to *Q. tuitensis*. Hurricane Lidia, a powerful category 4 hurricane, made landfall along the pacific coast of Mexico in October 2023. This directly impacted the habitat of *Q. tuitensis*, felling many large trees (Cristóbal Sánchez, personal communication, 2023). Within the inferred native range of *Q. tuitensis* the subtropical moist forest is expected to decrease in area by an average of 12% by the years 2061–2080 relative to current conditions (Good et al., 2024).

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

Pests and/or pathogens: Unknown.

Extremely small and/or restricted population: *Quercus tuitensis* has a very restricted distribution to the northwest slope of the Sierra Madre del Sur, El Tuito Cabo Corrientes Municipality and Talpa de Allende Municipality, Jalisco. Additional survey work is needed to determine if this species is in fact more widespread within the area.

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. tuitensis* (Table 1). 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 3). 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.

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

Number of ex *situ* collections reporting this species	0
Number of plants in ex *situ* collections	NA
Average number of plants per institution	NA
Percent of ex *situ* plants of wild origin	NA
Percent of wild origin plants with known locality	NA

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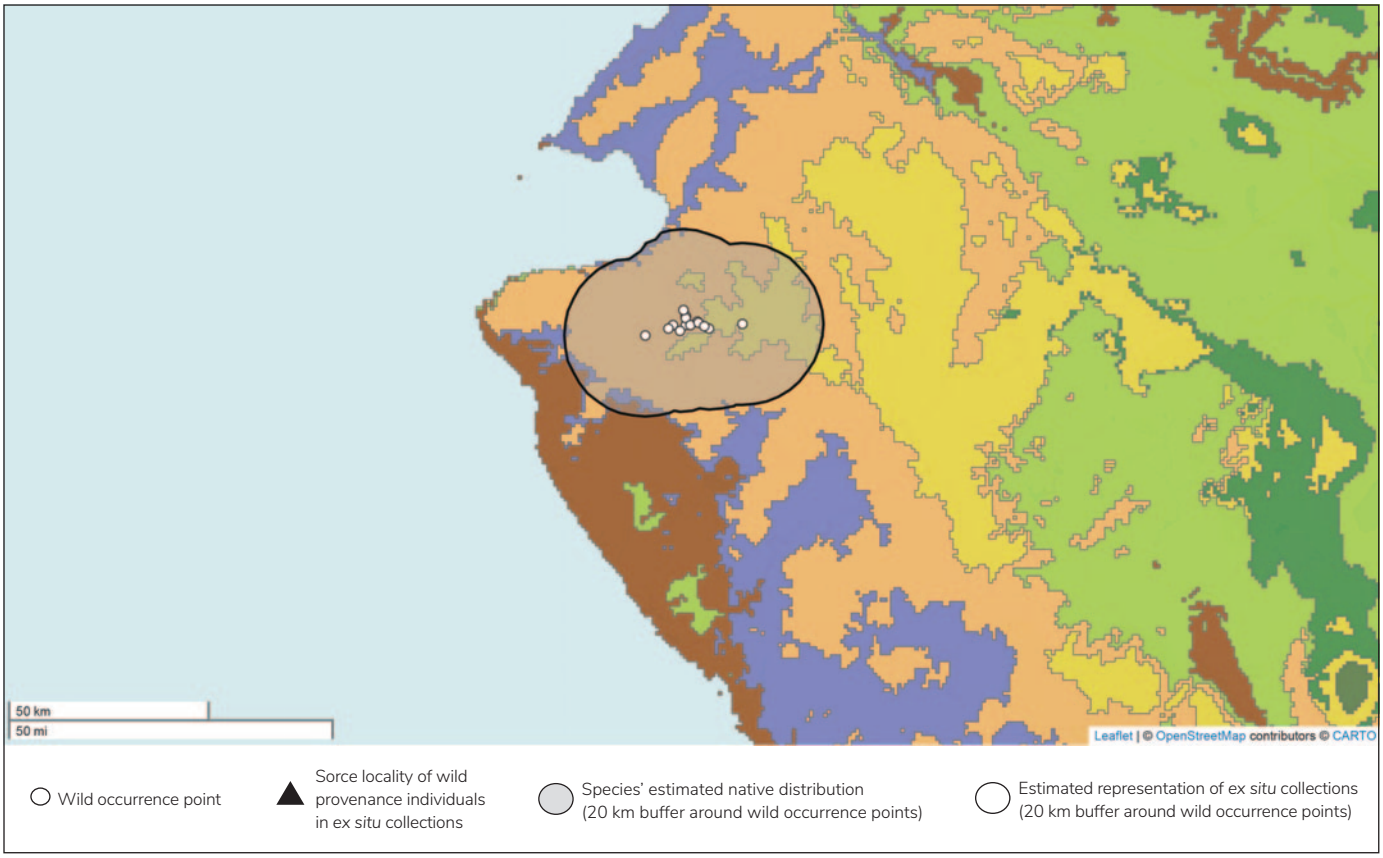

Figure 3. *Quercus tuitensis* wild occurrence points and *ex situ* collection source localities. Colored regions are Holdridge life zones. All *ex situ* collection source localities are also wild occurrence points.

Table 2. *Ex situ* conservation scores for *Quercus tuitensis* 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*	0
Ecological coverage *ex situ*	0
Representation in *ex situ* collections	0
Final *ex situ* conservation score	0

Using methods adapted from Khoury et al. (2020), we estimated the degree of representation of *Q. tuitensis* 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 4; 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.

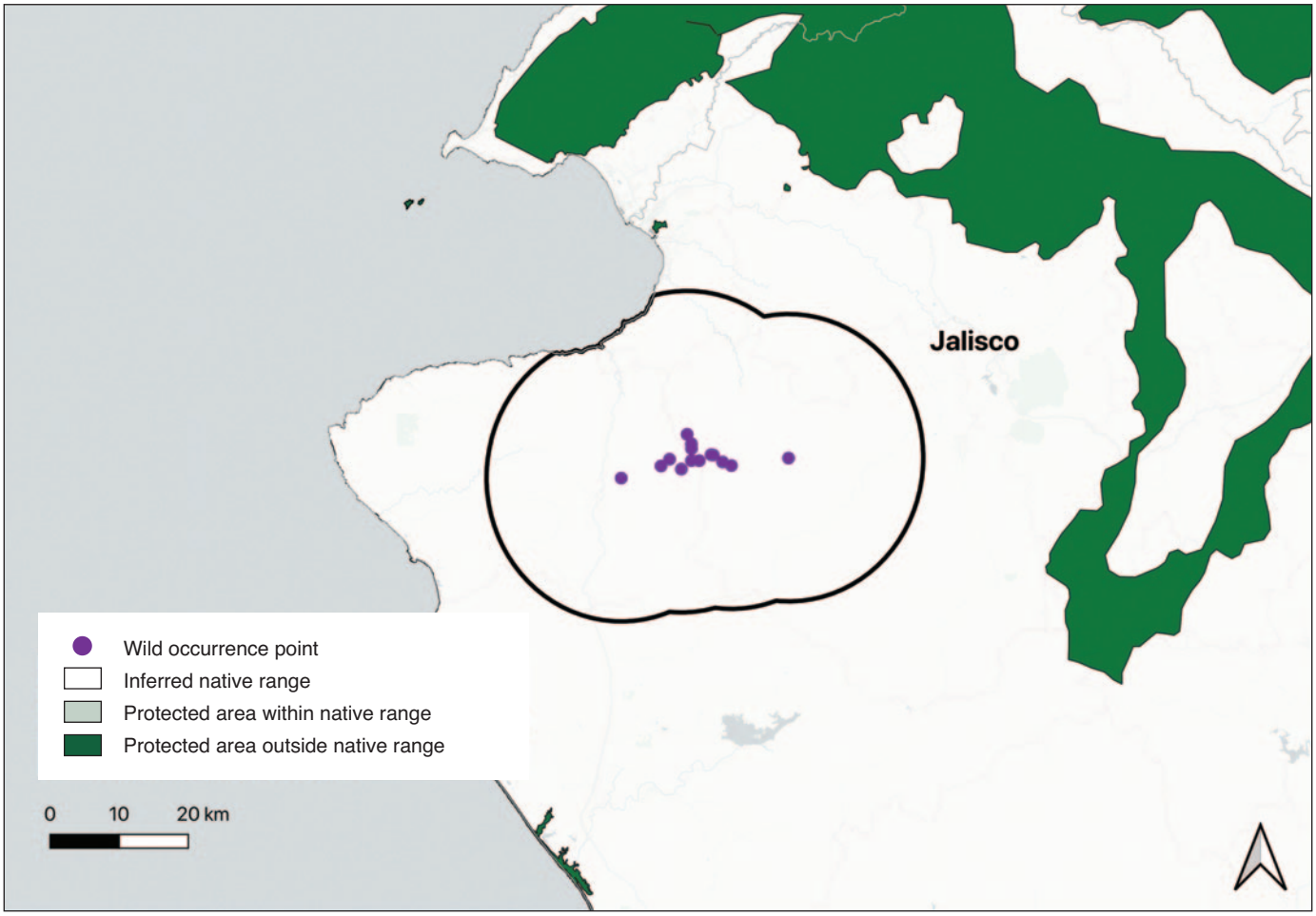

Figure 4. Wild occurrence points and inferred native range of *Quercus tuitensis* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023.

Table 3. *In situ* conservation scores for *Quercus tuitensis* 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*	0
Ecological coverage *in situ*	0
Species representation in *in situ* collections	0
Final *in situ* conservation score	0

Land protection: There are no protected areas within the inferred native range of *Q. tuitensis* (Figure 4). In January 2024 a new biosphere reserve was established, the Sierra de Vallejo-Río Ameca, located in the municipalities of Bahía de Banderas and Compostela (state of Nayarit) and in the municipalities of Mascota, Mixtlán, San Sebastián del Oeste and Puerto Vallarta (state of Jalisco). Although it is not within the known habitat of *Q. tuitensis*, it is an important addition to the region and it is possible that this species could occur here.

Sustainable management of land: This is not a conservation activity at the time of publication.

Population monitoring and/or occurrence surveys: Unknown.

Wild collecting and/or *ex situ* curation: Seeds were collected from a mother tree as part of a germination trial (Arenas-Navarro, unpublished). There are no surviving seedlings from this trial. According to the results of our *ex situ* survey, this species is not held in any *ex situ* collections.

Propagation and/or breeding programs: *Quercus tuitensis* has been propagated as part of a recent experiment comparing germination rates of oaks growing from humid vs dry environments (Arenas Navarro, unpublished). A majority of *Q. tuitensis* seedlings died during the experiment.

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

Research: Two recent studies investigated leaf and stem functional traits (Arenas-Navarro et al., 2020) as well as wood anatomical traits (Arenas-Navarro et al., 2021) of oak species along an environmental gradient in Jalisco, Mexico, and Q. *tuitensis* was among the study species. Funding through the International Oak Society (IOS) for a project titled "Protection and Conservation Actions through the Extinction Risk Assessment Method for Five Endemic Mexican Oak Species" was awarded in 2023. *Quercus tuitensis* is among the five target species. The project will include research on the effect of climate change on species distribution and germination rates.

Education, outreach, and/or training: A team led by Dra Maribel Arenas Navarro has discussed current conservation activities related to Q. *tuitensis* in schools and the community in Cuale. Stickers, educational materials, and games were shared with students.

Species protection policies: There are currently no species protection policies for Q. *tuitensis*.

PRIORITY CONSERVATION ACTIONS

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

Wild collecting and/or ex *situ* curation

According to the results of our ex *situ* surveys, Q. *tuitensis* is not currently held in any ex *situ* collections. This species is restricted to a very small region near the coast in Jalisco that has already seen its habitat directly impacted by hurricanes. Establishing Q. *tuitensis* in collections within Mexico should be a priority.

Land Protection

There are no protected areas within the native range of Q. *tuitensis*, and this species is threatened by land use change due to mining, grazing, and rural and urban development. Establishing Q. *tuitensis* within protected areas is crucial to conserve this species

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