

Conservation Gap Analysis of Native Mesoamerican Oaks

Béatrice Chassé



Species profile: *Quercus meavei*

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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 meavei Valencia-A., Sabás & Soto

IUCN Red List Category and Criteria: Vulnerable B1ab(iii)+2ab(iii)

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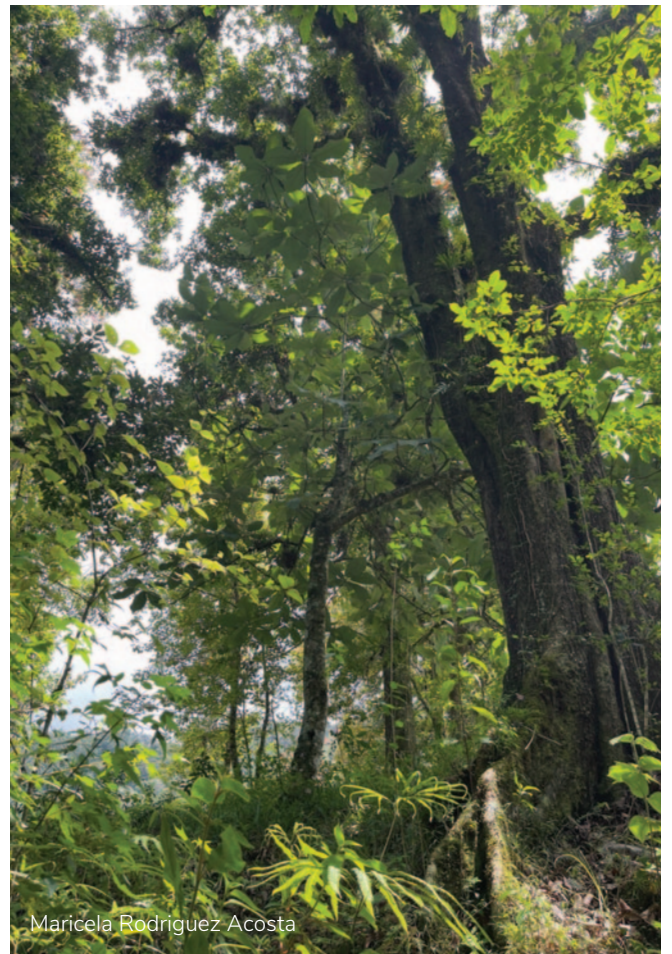
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DISTRIBUTION AND BIOLOGY

Quercus meavei is a recently described species of oak that occurs within the Sierra Madre Oriental in the Mexican states of Hidalgo, Puebla, San Luis Potosí, and Veracruz (Figure 1). It is a large tree that can grow up to 30 m. *Quercus meavei* prefers areas of high humidity (>90%) or to grow near small streams, and can be found in warm temperate rainforests and oak-forests (Valencia-A et al., 2016; Argüelles-Marrón et al., 2023; Figure 2). It grows in association with species such as *Liquidambar styraciflua*, *Quercus corrugata*, *Q. sartorii*, *Q. delgadoana*, *Carpinus tropicalis*, and *Fagus grandifolia* subsp. *mexicana*. (Valencia-A et al., 2016)



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



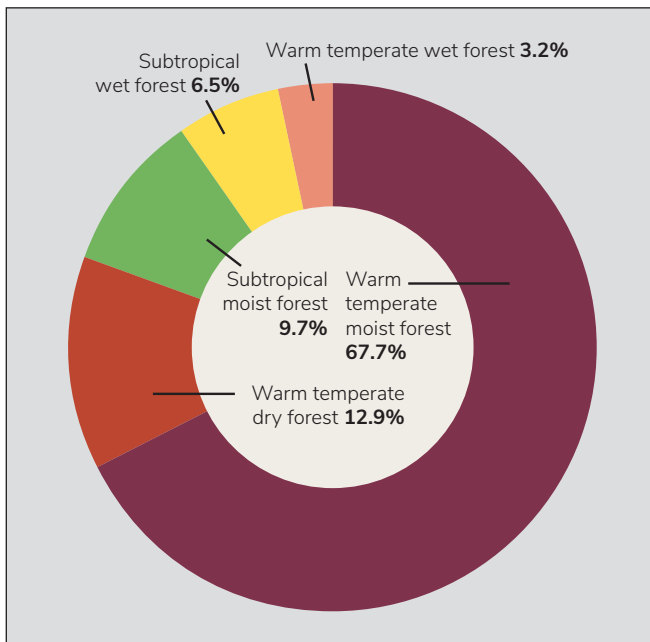


Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus meavei* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: Acorns of *Q. meavei* are used to make crafts. Wood is obtained for the construction of fences and beams. It is also used for firewood.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: The creation of pastures for cattle grazing is common in areas where *Q. meavei* grows.

Human use of landscape — residential/commercial development, mining, and/or roads: There is a tendency to pipe river water in Mexico in order to direct the water to towns. This severely modifies the habitat of *Q. meavei*, which occupies the banks of rivers in the cloud forest. Additionally, cutting of large trees such as *Q. meavei* occurs to make way for development.

Human use of landscape — tourism and/or recreation: This is not considered a major threat. Tourism and recreation in the areas where *Q. meavei* develops is not reported.

Human modification of natural systems — altered fire regime, pollution, eradication: Unknown.

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

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: The species is distributed along river banks and in the most humid areas of the cloud forest (“bosque mesófilo de montaña” sensu Rzedowski, 2006). As a result, a decrease in precipitation associated with climate change will have severe consequences for *Q. meavei*. This species is especially vulnerable to climate change as a tropical montane cloud forest species, and also due to its small populations and limited long-distance seed dispersal. Within the inferred native range of *Q. meavei*, the warm temperate moist forest is expected to decrease in area by an average of 61% by the years 2061–2080 relative to current conditions (Good et al., 2024).

Genetic material loss — inbreeding and/or introgression: This is not currently considered to be a threat. There are no known specimens or individuals that suggest hybridization and introgression of any oak species with *Q. meavei*.

Pests and/or pathogens: Unknown.

Extremely small and/or restricted population: Populations are fragmented in the cloud forest of San Luis Potosí, Veracruz, Hidalgo and Puebla.



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. meavei* (Table 1, Figure 3). Past, present, and planned conservation activities for Mesoamerican oak species of concern were also examined through a 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 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	3
Number of plants in ex situ collections	6
Average number of plants per institution	2
Percent of ex situ plants of wild origin	33%
Percent of wild origin plants with known locality	100%



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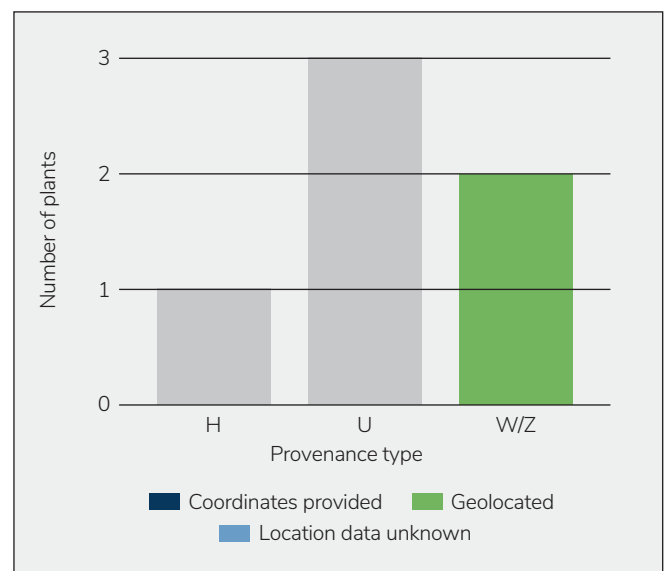


Figure 3. Number and origin of *Quercus meavei* plants in ex situ collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

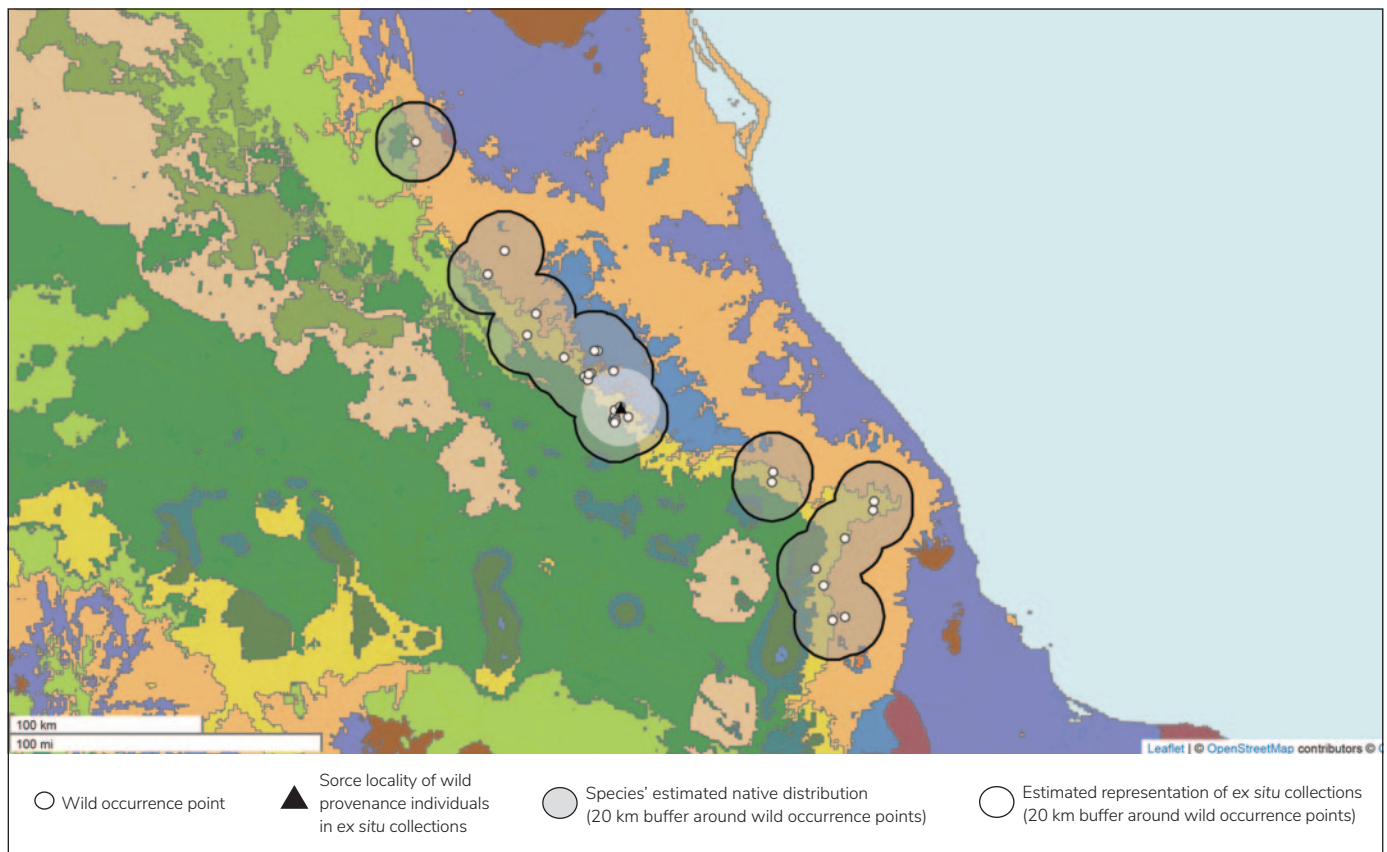


Figure 4. *Quercus meavei* wild occurrence points and ex situ collection source localities. Colored regions are Holdridge life zones. All ex situ collection source localities are also wild occurrence points.

Table 2. Ex situ conservation scores for *Quercus meavei* 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	9
Ecological coverage ex situ	45
Representation in ex situ collections	10
Final ex situ conservation score	21

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

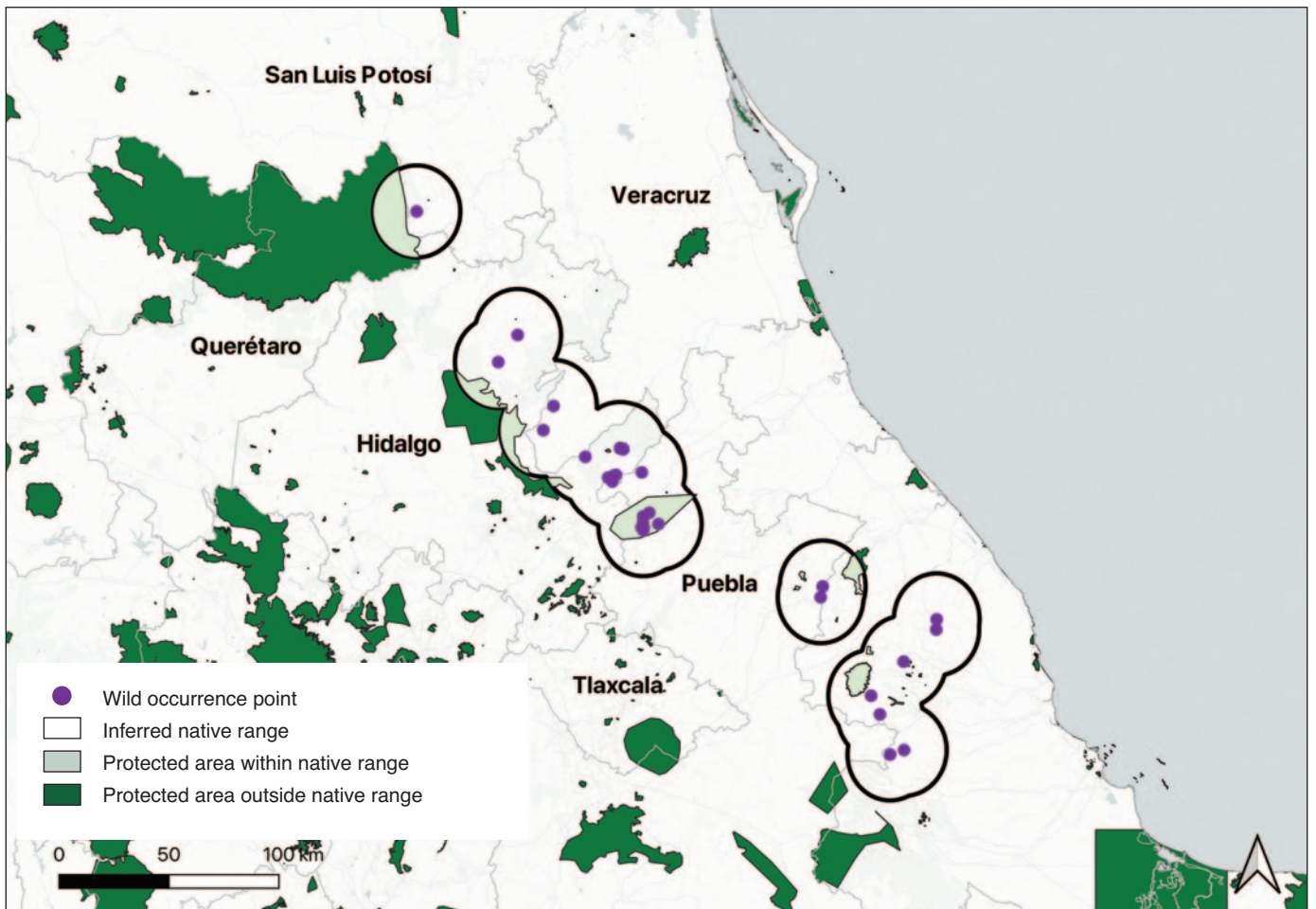


Figure 5. Wild occurrence points and inferred native range of *Quercus meavei* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).



Table 3. *In situ* conservation scores for *Quercus meavei* 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>	11
Ecological coverage <i>in situ</i>	82
Species representation in <i>in situ</i> collections	21
Final <i>in situ</i> conservation score	38

Land protection: Within the inferred native range of *Q. meavei*, 11% is within protected areas (Figure 5). This species is known to occur in the Sistema de Represas y Corredores biológicos de la Cuenca Hidrográfica del Río Necaxa, a Ramsar site in Puebla.

Sustainable management of land: Unknown.

Population monitoring and/or occurrence surveys:

Recently, populations of *Q. meavei* were identified in Veracruz near Totoyac, Tetlaxca, and Zapotal. A new population was also discovered in El Zapotal, ejido San Pedro Buenavista. All are outside of protected areas.

Wild collecting and/or ex situ curation: According to the results of our ex situ surveys, this species is held in three ex situ collections. In addition, two new ex situ collections are planned to be established in Xalapa, Veracruz in 2024.

Propagation and/or breeding programs: A recent study reported a germination rate of 62% for *Q. meavei* (Castañón-Malpica, 2024).

Reintroduction, reinforcement, and/or translocation: A total of 281 saplings have been planted across 60 sites in the upper watershed of river La Antigua, Veracruz in 2023. Additionally, 155 saplings will be planted throughout in 2024.

Research: Research about the drought events and wood anatomy sensitivity in *Q. meavei* and *Q. delgadoana* have been done (Argüelles-Marron et al., 2023). The authors found both *Q. meavei* and *Q. delgadoana* showed high resilience, resistance, and recovery to drought. The effect of pre-germinative treatments on the germination of *Q. meavei* has also been studied as part of an undergraduate thesis (Castañón-Malpica, 2024). The effect of elevation and soil conditions on the growth and survival of transplanted saplings of *Q. meavei* in disturbed areas is being conducted in central Veracruz, Mexico.

Education, outreach, and/or training: Various outreach activities, such as workshops to propagate acorns with local nurseries, focused on the importance of oaks and the restoration of riparian cloud forests with local communities, are being carried out in the upper part of the La Antigua watershed to promote the valuation and conservation of oaks of the cloud forest, including *Q. meavei*.

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

PRIORITY CONSERVATION ACTIONS

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

Land protection

Only 11% of the native range of *Q. meavei* is covered by protected areas. Establishing new protected areas should be a conservation priority. However, this is a challenge in Mexico, as most cloud forests are the property of small landholders who rely on the land for subsistence.

Wild collecting and/or ex situ curation

Wild collecting throughout the species' range and establishment in additional ex situ collections in Mexico is needed.

Reintroduction, reinforcement, and/or translocation

Restoration of populations in close collaboration with local communities is needed. This should include assisted regeneration with an emphasis in riparian forests.



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