Conservation Gap Analysis of Native

Mesoamerican Oaks

Béatrice Chassé

Species profile: ***Quercus miquihuanensis***

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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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CSS TREES Center for Species Survival
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Quercus miquihuanensis Nixon & C.H.Müll.

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

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DISTRIBUTION AND BIOLOGY

Quercus miquihuanensis is endemic to the northern Sierra Madre Oriental in the Mexican states of Nuevo León and Tamaulipas (Figure 1). It inhabits dense chaparral and conifer-oak woodlands. Most known occurrences of this species are in two Holdridge life zones: warm temperate dry forest and warm temperate thorn scrub (Figure 2). It can be found at an elevation of 2,500–3,050 m asl in some of the highest areas of Tamaulipas (Jerome, 2020). In this region, at least one month of the year is below 7.5°C and 1–4 months of the year have very little rain (Morales Pacheco et al., 2018). As such, it is adapted to colder climates and little rainfall.

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

Quercus miquihuanensis grows in association with species such as *Q. galeanensis*, *Arbutus xalapensis*, *Comarostaphylis polifolia*, *Arctostaphylos pungens* and *Garrya* spp. (Nixon and Muller, 1993).

Quercus miquihuanensis is described by Nixon and Muller (1993) as "a striking and attractive dense green shrub". It can reach heights of 2 m, and is 2 m wide. Leaves are evergreen, narrowly elliptic, ovate or obovate, 3.5–4 cm long x 1–2 cm wide. The upper leaf surface is dark green and the lower leaf surface is rusty or tawny. (Nixon and Muller, 1993)

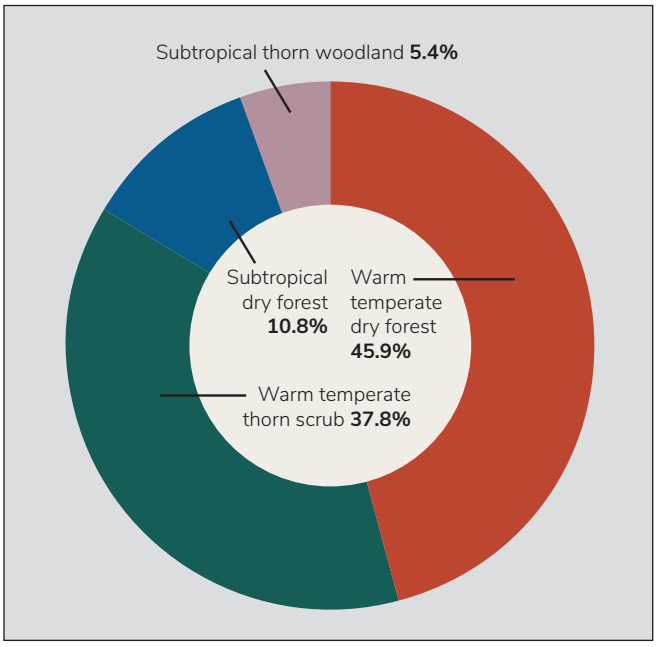

Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus miquihuanensis* is distributed.


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THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: Unknown.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: There is free grazing within the native habitat of *Q. miquihuanensis*.

Human use of landscape — residential/commercial development, mining, and/or roads: The ecosystem is slightly modified by the construction of dirt roads. This is an incipient threat that is expected to increase in the near future.

Human use of landscape — tourism and/or recreation: Tourism is beginning to develop within the region.

Human modification of natural systems — altered fire regime, pollution, and/or eradication: This is not currently considered a threat.

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

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Within the inferred native range of *Q. miquihuanensis*, the warm temperate dry forest is expected to decrease in area by an average of 48% 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: Populations of *Q. miquihuanensis* are small.

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. miquihuanensis* (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 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	16
Number of plants in *ex situ* collections	26
Average number of plants per institution	2
Percent of *ex situ* plants of wild origin	35%
Percent of wild origin plants with known locality	0%

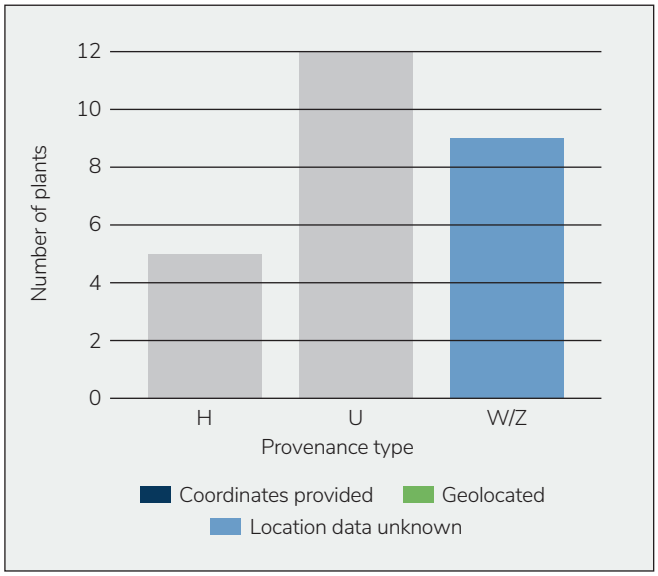

Figure 3. Number and origin of *Quercus miquihuanensis* plants in *ex situ* collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

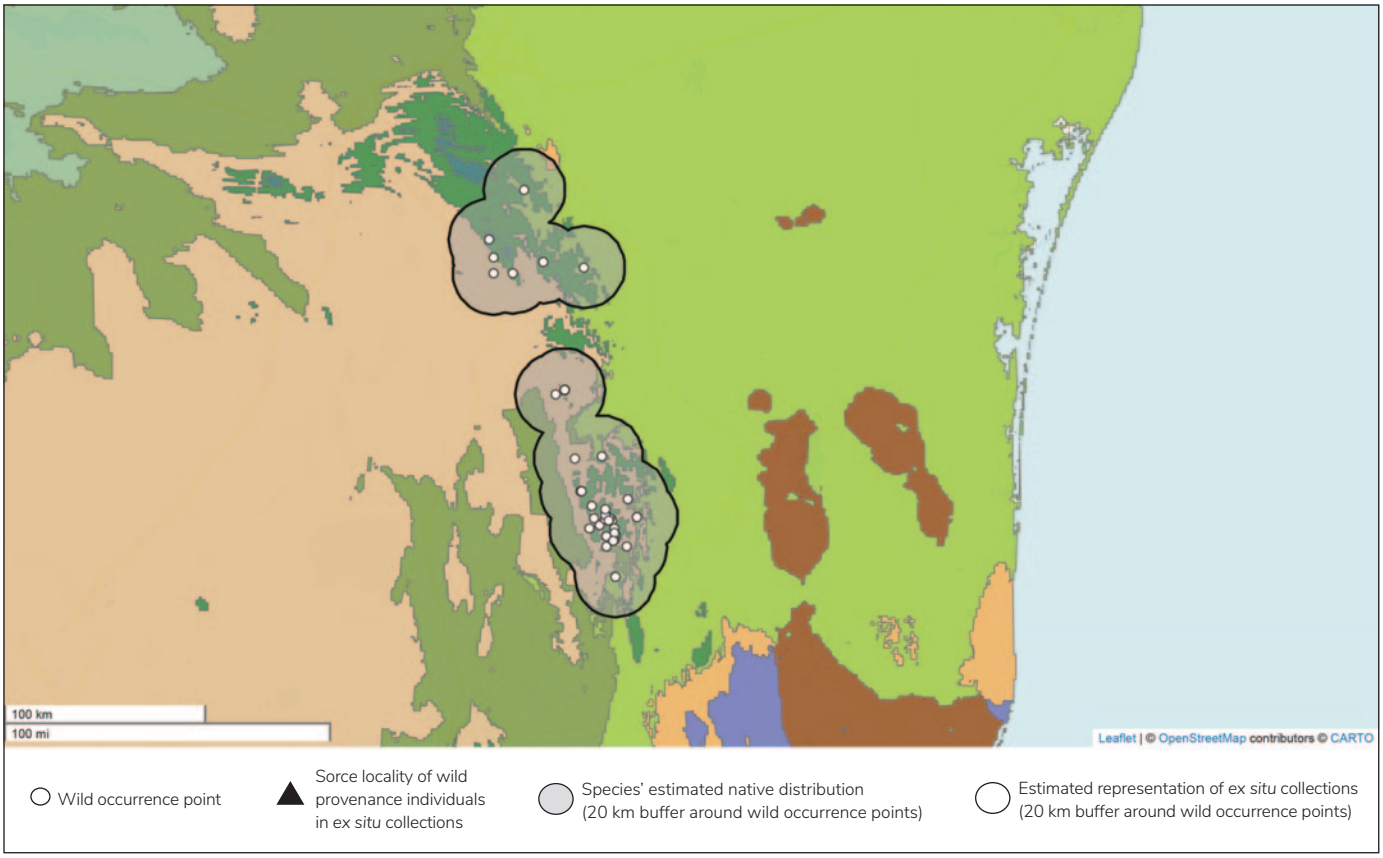

Figure 4. *Quercus miquihuanensis* wild occurrence points and *ex situ* collection source localities. Colored regions are Holdridge life zones. All *ex situ* collection source localities are also wild occurrence points.

Table 2. *Ex situ* conservation scores for *Q. miquihuanensis* 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	30
Final *ex situ* conservation score	10

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

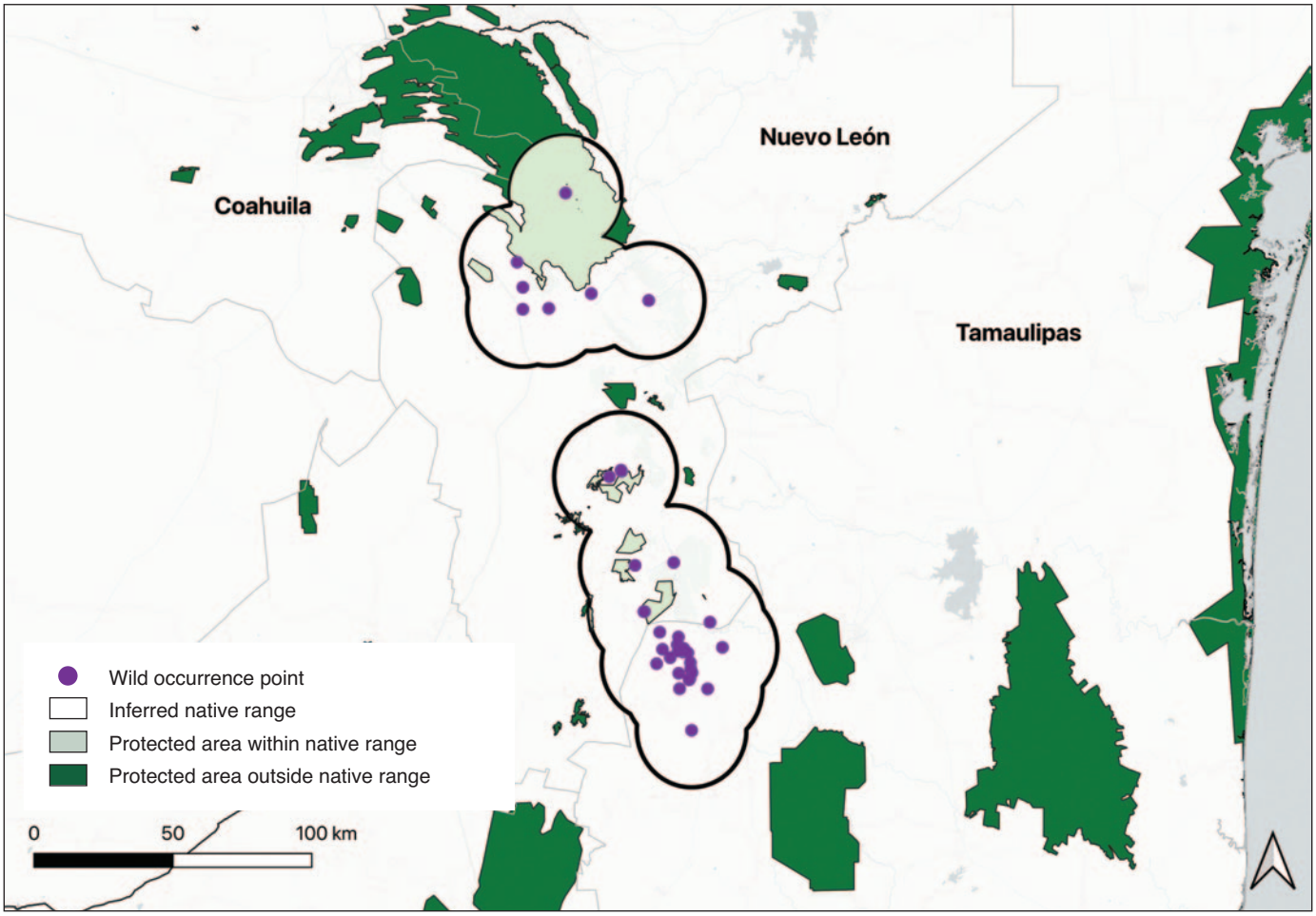

Figure 5. Wild occurrence points and inferred native range of *Quercus miquihuanensis* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023.

Table 3. *In situ* conservation scores for *Quercus miquihuanensis* 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*	17
Ecological coverage *in situ*	83
Species representation in *in situ* collections	3
Final *in situ* conservation score	34

Land protection: Within the inferred native range of *Q. miquihuanensis*, 17% is within protected areas (Figure 5). A protected natural area called Monarch Butterfly Natural Landscape was recently decreed in the state of Tamaulipas, which includes populations of *Q. miquihuanensis*.

Sustainable management of land: Unknown.

Population monitoring and/or occurrence surveys: Unknown.

Wild collecting and/or *ex situ* curation: According to the results of our *ex situ* surveys, this species is currently held in 16 collections. However, for most individuals, provenance data is unknown. For those of wild provenance, there is no locality information.

Propagation and/or breeding programs: Seeds have been collected for germination and propagation.

Reintroduction, reinforcement, and/or translocation: Unknown.


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Research: There is relatively little research focus on this species. A recent phylogenetic study investigating evolutionary patterns of Internal Transcribed Spacers (ITS) in red oaks included *Q. miquihuanensis* in its list of target species (Vázquez, 2019). Another recent study looked at leaf mass per area in relation to climate and phylogeny of deciduous oaks, including *Q. miquihuanensis* (Sancho-Knapik et al., 2021).

Education, outreach, and/or training: A project on environmental education for this species was recently approved at the Autonomous University of Tamaulipas.

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

PRIORITY CONSERVATION ACTIONS

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

Wild collecting and/or *ex situ* curation

While *Q. miquihuanensis* is currently held in 16 collections, the source localities for wild collected individuals are unknown. Additional wild collecting from throughout the species native range is necessary.

Education outreach, and/or training

Educating the local community on the conservation value of *Q. miquihuanensis* should be a priority.

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