

Conservation Gap Analysis of Native Mesoamerican Oaks



Francisco Garin

Species profile: *Quercus diversifolia*

Kate Good, Oscar Javier Soto Arellano, Victor Garcia Balderas,
Silvia Alvarez-Clare

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



THE
CHAMPION
of TREES



Quercus diversifolia Née

Common Names, Spanish: Encino de Chalma

IUCN Red List Category and Criteria: Endangered: B2ab(iii)

Species profile expert: **Oscar Javier Soto Arellano**, Instituto Nacional de Estadística y Geografía (INEGI)

Suggested citation: Good, K., Soto Arellano, O. J., Garcia Balderas, V., and Alvarez-Clare, S. (2024). *Quercus diversifolia* Née. In Good, K., Coombes, A. J., Valencia-A, S., Rodríguez-Acosta, M., Beckman Bruns, E., and Alvarez-Clare, S. Conservation Gap Analysis of Native Mesoamerican Oaks. (pp. 149-156). Lisle, IL: The Morton Arboretum.

DISTRIBUTION AND BIOLOGY

Quercus diversifolia is endemic to Mexico where it is found in the states of Mexico (Huixquilucan, Naucalpan de Juárez and Ocuilan), Distrito Federal (Cuajimalpa de Morelos, La Magdalena Contreras, Tlalpan), and Puebla (Figure 1). It inhabits oak, pine-oak and oyamel forests at an altitude of 2,400–2,600 meters asl. The taxonomic uncertainty surrounding this species has historically led to its range being identified as much larger than it actually is. *Quercus diversifolia* is often confused with *Q. greggii* in northern Mexico and in the center-west of Mexico with *Q. laeta* (Jerome and Beckman, 2018). Over time there have been re-descriptions in which new features have been added to the original description derived from the observation of specimens from other Mexican states. Field work is required to collect specimens that correspond to the original description of this species.



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



There is very little information on *Q. diversifolia*. According to the original description, it is a small tree that can grow up to 4 meters. Leaves are ovate with thick teeth towards the tip. A majority of known occurrences are in the warm temperate dry forest life zone (Figure 2).

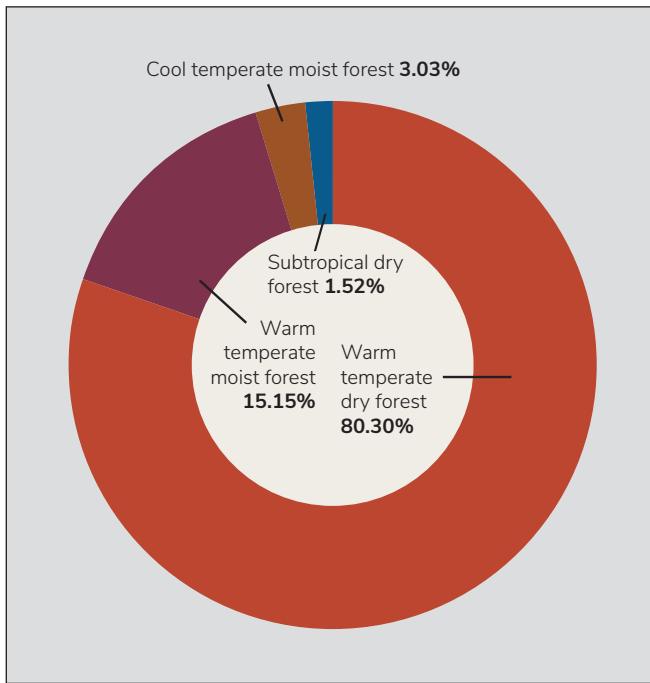


Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus diversifolia* is distributed.



THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: There are reports of the species being harvested for charcoal, as is the case with many species of oaks in Mexico (Soto Torres and Vázquez Solís, 2020).

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: Unknown.

Human use of landscape — residential/commercial development, mining, and/or roads: Residential development is the greatest threat to *Q. diversifolia*. Much of this species' population is in or near Mexico City and is impacted by urban development and population growth.

Human use of landscape — tourism and/or recreation: Unknown.

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: Within the inferred native range of *Q. diversifolia*, the warm temperate dry forest is expected to decrease in area by an average of 23% 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: Unknown.

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. diversifolia* (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

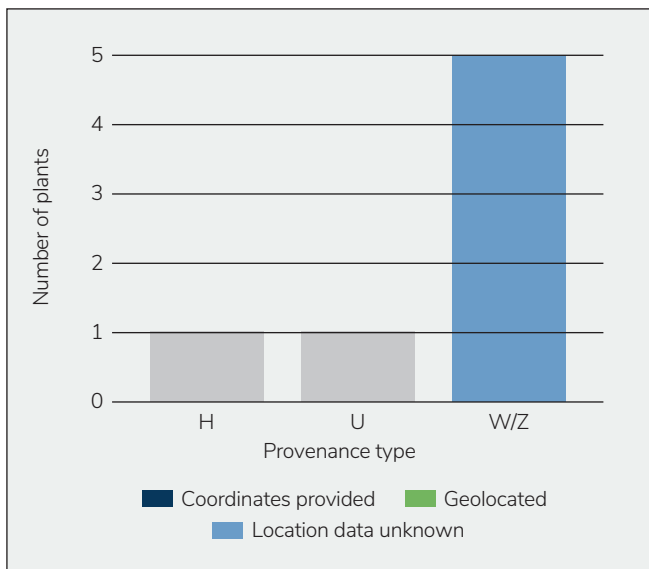


Figure 3. Number and origin of *Quercus diversifolia* plants in ex situ collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

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

Number of ex situ collections reporting this species	4
Number of plants in ex situ collections	7
Average number of plants per institution	2
Percent of ex situ plants of wild origin	71%
Percent of wild origin plants with known locality	0%

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.

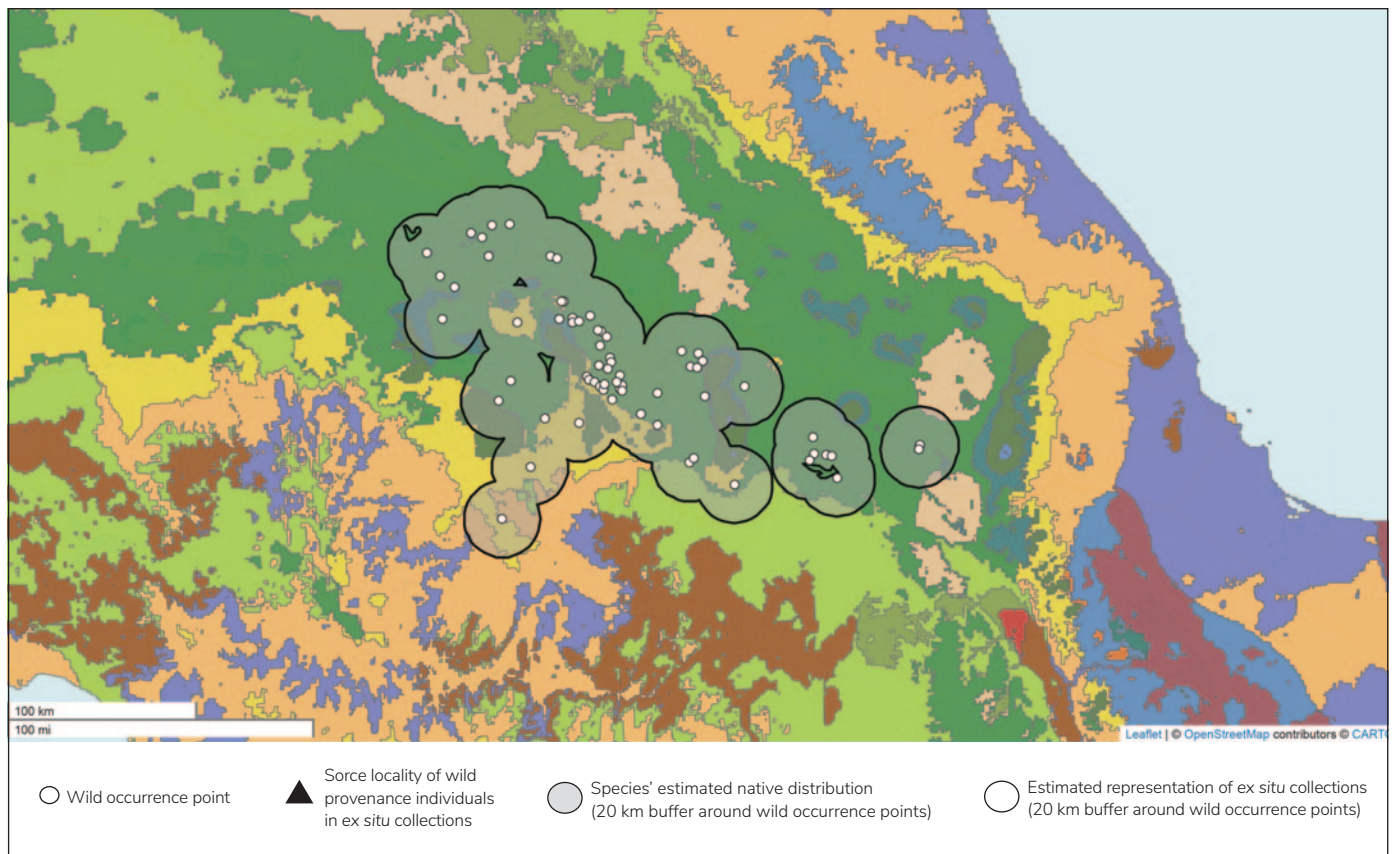


Figure 4. *Quercus diversifolia* wild occurrence points. Colored regions are Holdridge life zones.

Table 2. Ex situ conservation scores for *Quercus diversifolia* 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	20
Final ex situ conservation score	7

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

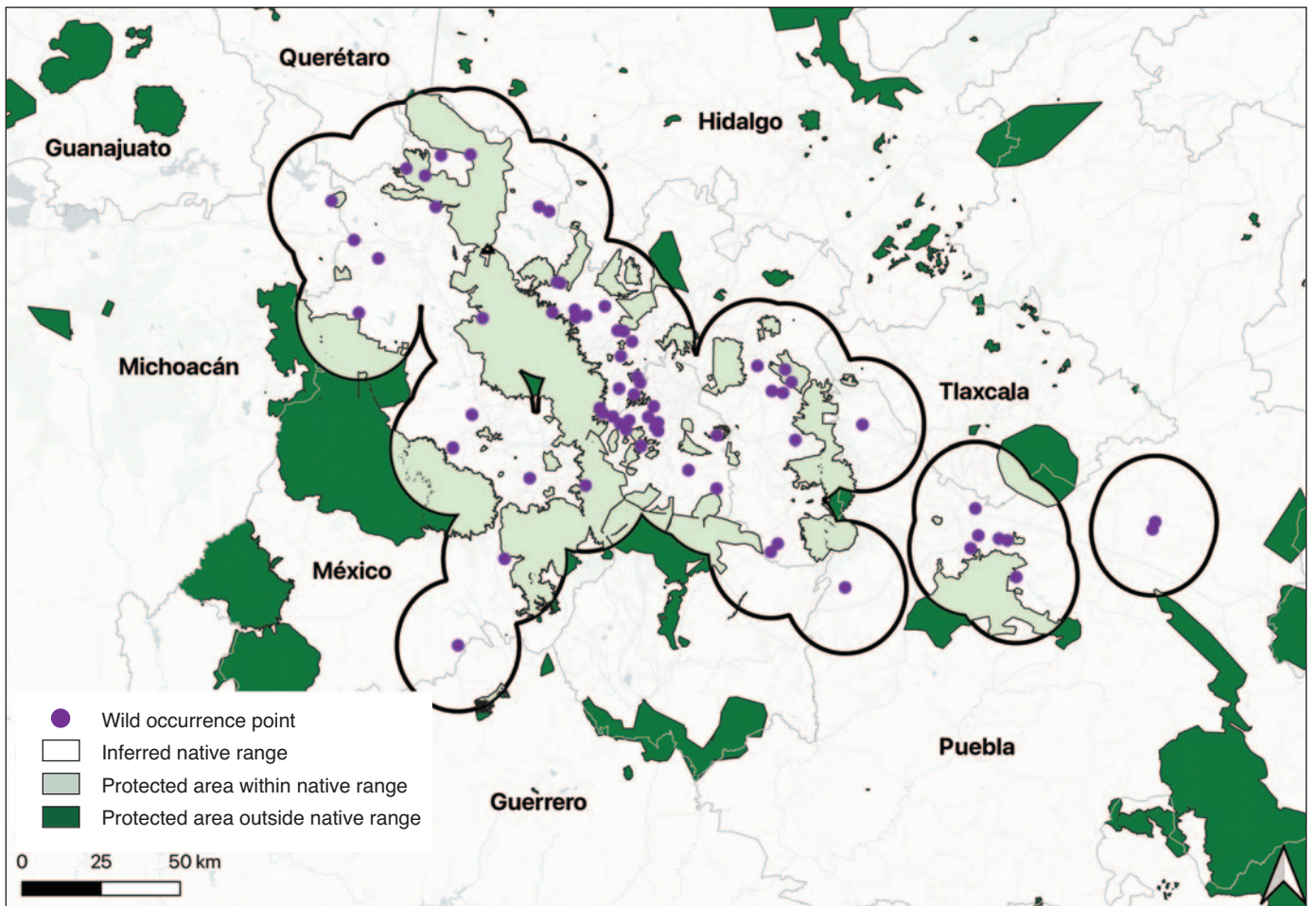


Figure 5. Wild occurrence points and inferred native range of *Quercus diversifolia* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).

Table 3. *In situ* conservation scores for *Quercus diversifolia* 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>	27
Ecological coverage <i>in situ</i>	78
Species representation in <i>in situ</i> collections	21
Final <i>in situ</i> conservation score	42

Land protection: Within the inferred native range of *Q. diversifolia*, 27% is within protected areas (Figure 5). Protected areas include Zempoala - La Bufa Otomí-Mexica (Ecological Park), and Sistema Tetzcotzinco (State Reserve).

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

Population monitoring and/or occurrence surveys: This is not a conservation activity at the time of publication.

Wild collecting and/or ex situ curation: According to the results of our 2017–2022 ex situ surveys, this species is held in four collections. However, the provenance information is unknown.

Propagation and/or breeding programs: This is not a conservation activity at the time of publication.

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

Research: There is little to no research focusing on *Q. diversifolia* at the time of publication.

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

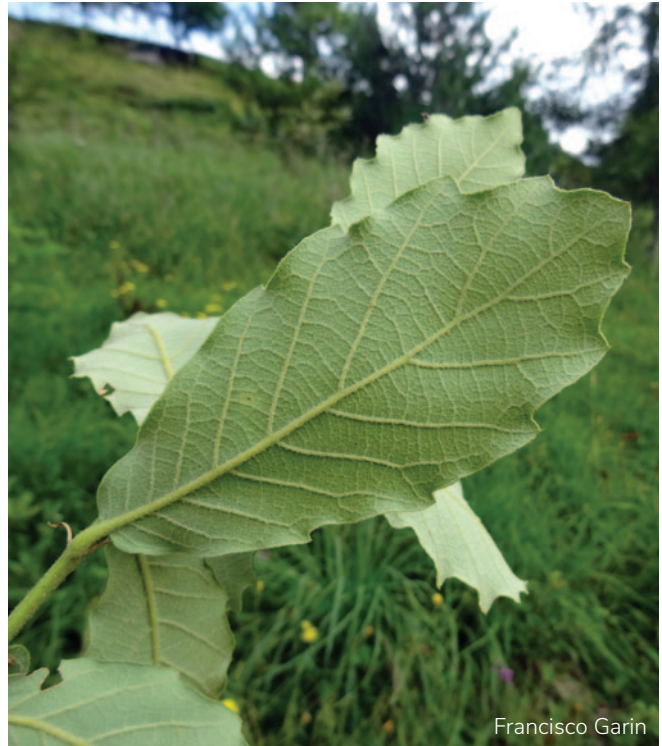
Species protection policies: This is not a conservation activity at the time of publication.

PRIORITY CONSERVATION ACTIONS

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

Research

Quercus diversifolia is not well defined, and experts disagree on its taxonomic status. More research on taxonomy/phylogenetics is needed to determine the status of this species.



REFERENCES

Good, K., Coombes, A. J., Valencia-A, S., Rodríguez-Acosta, M., Beckman Bruns, E., and Alvarez-Clare, S. 2024. Conservation Gap Analysis of Native Mesoamerican Oaks. Lisle, IL: The Morton Arboretum.

Jerome, D. and Beckman, E. 2018. *Quercus diversifolia*. The IUCN Red List of Threatened Species 2018: e.T78911398A78911414. Available at <https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T78911398A78911414.en>. Accessed February 2024.

Khoury, C. K, Carver, D., Greene, S. L., and Frances, A. 2020. Crop wild relatives of the United States require urgent conservation action. PNAS 117(52): 33351–33357. <https://doi.org/10.1073/pnas.2007029117>

Soto Torres, M. L. and Vázquez Solís, V. 2020. "Evaluation of environmental conditions as an instrument of community alternative tourism projects in the Sierra de Álvarez, San Luis Potosí". In V. Vázquez Solís and A. Sánchez Crispín. (Eds), *Arreglo territorial del turismo en América Latina: Casos de México, Costa Rica y Paraguay*. Universidad Nacional Autónoma de México

UNEP-WCMC and IUCN. 2023. Protected Planet: The World Database on Protected Areas (WDPA) [Online] Cambridge, UK. Available at www.protectedplanet.net. Accessed 2023.

