Conservation Gap Analysis of Native

Mesoamerican Oaks


Béatrice Chassé

Species profile: ***Quercus delgadoana***

Kate Good, Susana Valencia-A, Tarin Toledo-Aceves,
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

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Franklinia Foundation

Quercus delgadoana S.Valencia, Nixon & L.M.Kelly

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

Species profile experts: Susana Valencia-A, Universidad Nacional Autónoma de México (UNAM); Tarin Toledo-Aceves, INECOL

Suggested citation: Good, K., Valencia-A., S., Toledo-Aceves, T., Garcia Balderas, V., and Alvarez-Clare, S. (2024). *Quercus delgadoana* S.Valencia, Nixon & L.M.Kelly. 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. 133-140). Lisle, IL: The Morton Arboretum.

DISTRIBUTION AND BIOLOGY

Quercus delgadoana is endemic to the Sierra Madre Oriental in Mexico, where it is found in the montane cloud forests of Hidalgo, Puebla, and Veracruz (Figure 1). It was first described in 2011 by Valencia et al. based on a type specimen in Hidalgo. *Quercus delgadoana* is often misidentified as *Q. eugeniifolia*, *Q. salicifolia*, and *Q. sapotifolia* (Valencia-A, 2011). Unlike the aforementioned three species, the fruits of Q. delgadoana mature biennially (i.e., fruits take two years to reach full maturity) in September and October. *Quercus delgadoana* has a narrow distribution in Mexican cloud forest at typical elevations of 1,200–2,200 m asl, with few subpopulations each having very few individuals (Valencia-A. and Gual-Díaz, 2014). Known occurrences of *Q. delgadoana* have been recorded in four Holdridge life zones, the most common being warm temperate moist forest (Figure 2).


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Quercus delgadoana is a large tree that can reach up to 30 m tall. Leaves are glabrous and narrowly longate, elliptic or lancelate. Acorns are ovoid and 18–23 mm long by 11–13 mm wide. This species is often found in beech forest plant associations (*Fagus grandifolia* subsp. *mexicana*) or in association with *Q. affinis*, *Q. corrugata*, and *Q. meavei*.

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

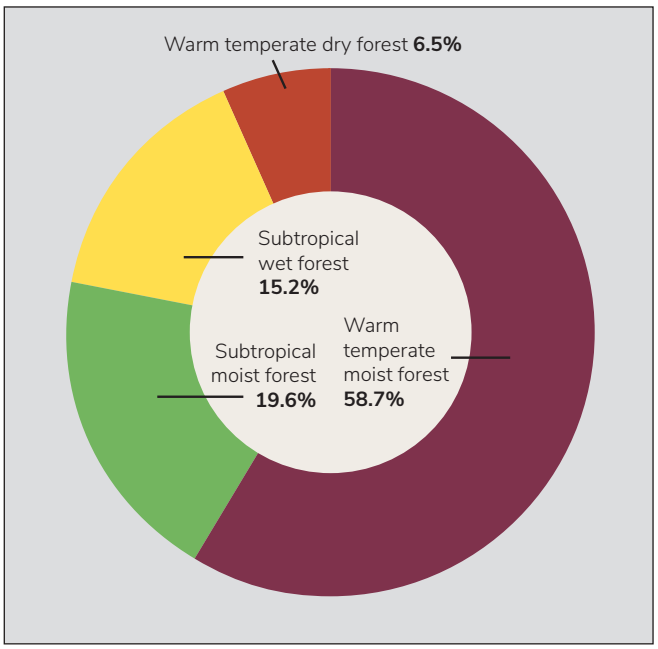

Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus delgadoana* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: While it is unknown if there is wild harvesting of *Q. delgadoana* specifically, oaks in Mexico are widely harvested to produce charcoal without any planning to secure the maintenance of the populations.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: The cloud forest habitat of the Sierra Madre Oriental and central Veracruz is under threat from firewood extraction, agricultural development, and the establishment of coffee plantations (CONABIO, 2010; Valencia-A et al., 2011). Isolated trees have been located in active pastures where recruitment of seedlings is not occuring due to the presence of cattle. *Quercus delgadoana* is frequently found with *Fagus grandifolia* subsp. *mexicana*, a species of beech in which seeds are commonly collected for consumption. Extracting seeds from this closely associated species alters the ecosystem as a whole where *Q. delgadoana* grows.

Human use of landscape — residential/commercial development, mining, and/or roads: The habitat of this species is fragmented by agricultural land and dirt roads that are heavily used. There are also several foot trails near the roads. Because *Q. delgadoana* lives in humid habitats, the roads expose the populations to a drier environment.

Human use of landscape — tourism and/or recreation: There is ecotourism in the area, but it is unknown whether this has an impact on the species.

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

Human modification of natural systems — invasive species competition/disturbance: This is not considered a threat at the time of publication. There are no specific studies for the populations of *Q. delgadoana*, however bracken (*Pteridum arachnoideum*) infestation, is a major barrier for tree recruitment in cloud forest areas in abandoned agricultural areas in Mexico.

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: The cloud forest habitat in which *Q. delgadoana* is found is especially susceptible to climate change. Rojas-Soto et al. (2012) estimate that there will be a 54–76% reduction in Mexican cloud forests by 2050, with the Sierra Madre Oriental especially impacted. In Mexico, a 68% reduction by 2080 (Ponce-Reyes et al., 2012), an 82% reduction by 2060 (Rehfeldt et al., 2012) and a 100% reduction between 2050 to 2070 (Helmer et al., 2019) have been estimated. Within the inferred native range of *Q. delgadoana*, the warm temperate moist forest is expected to decrease in area by an average of 68% 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: The species has small populations and a fragmented distribution limited to the wetter areas of the cloud forest. In addition, *Q. delgadoana* has a long reproductive cycle, producing fruit every 5–10 years once they have reached reproductive age. This results in slow population growth and recovery from degradation.

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. delgadoana* (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	11
Number of plants in ex *situ* collections	20
Average number of plants per institution	2
Percent of ex *situ* plants of wild origin	20%
Percent of wild origin plants with known locality	100%

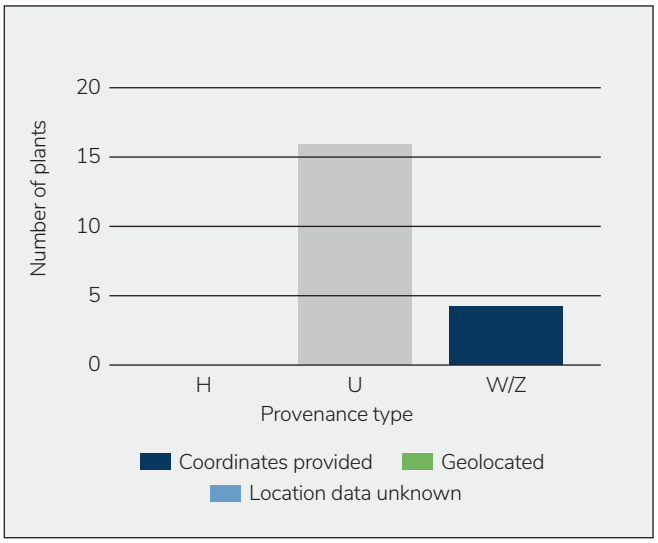

Figure 3. Number and origin of *Quercus delgadoana* plants in ex *situ* collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

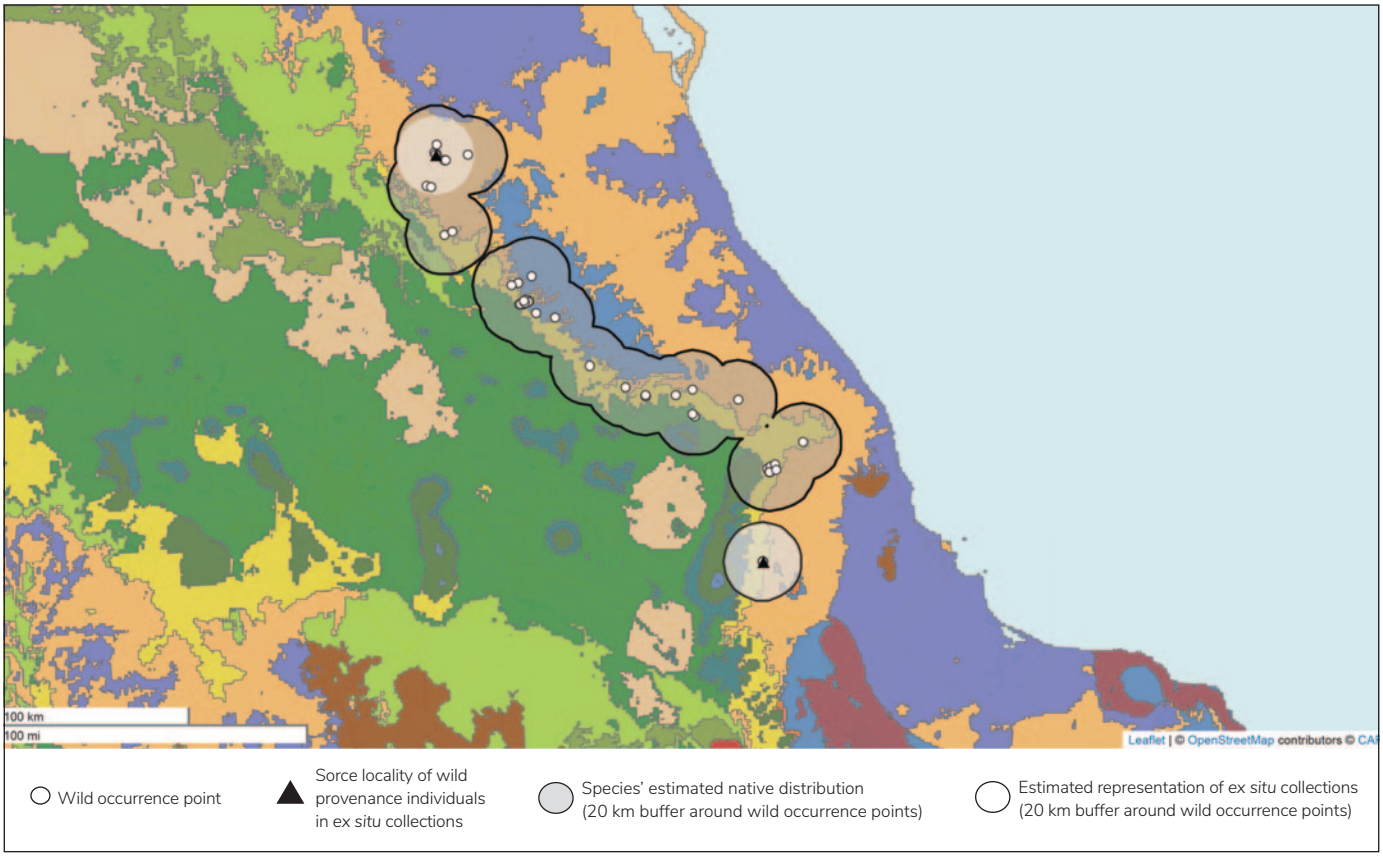

Figure 4. *Quercus delgadoana* wild occurrence points and *ex situ* collection source localities. Colored regions are Holdridge life zones. All *ex situ* collection source localities are also wild occurrence points.

Table 2. *Ex situ* conservation scores for *Quercus delgadoana* 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*	18
Ecological coverage *ex situ*	70
Representation in *ex situ* collections	40
Final *ex situ* conservation score	43

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

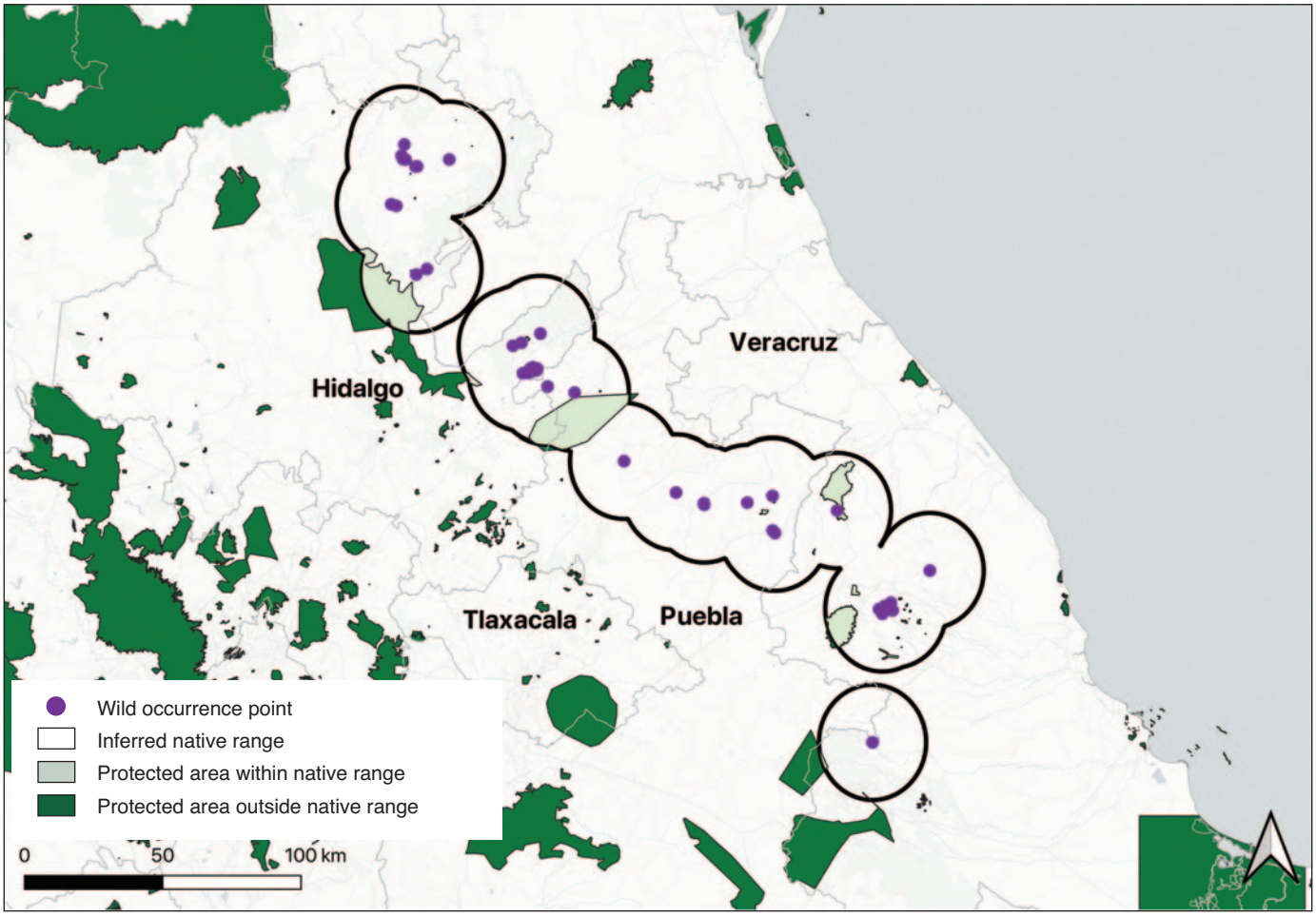

Figure 5. Wild occurrence points and inferred native range of *Quercus delgadoana* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023.

Table 3. *In situ* conservation scores for *Quercus delgadoana* 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*	7
Ecological coverage *in situ*	90
Species representation in *in situ* collections	3
Final *in situ* conservation score	33

Land protection: Within the inferred native range of *Q. delgadoana*, 7% is within protected areas (Figure 5). Major protected areas include Barranca de Metztitlán Biosphere Reserve in Hidalgo, Z. P. F. V. la Cuenca Hidrográfica del Río Necaxa in Puebla and Hidalgo, and the Río Filo-Bobos y su Entorno and Cofre de Perote o Nauhcampatépetl in Veracruz.

Sustainable management of land: All biosphere reserves in Mexico, including the Barranca de Metztitlán Biosphere Reserve in Hidalgo, are required to have a management plan, which regulates activities in the area and ensures that objectives of the reserve are achieved. However, this is not considered a conservation activity for this species because such a small proportion of the species' native range is managed.

Population monitoring and/or occurrence surveys: Isolated trees in active pasturelands have been located to collect seeds for propagation. Exploration of forest fragments was conducted between 2021 and 2023 to locate populations.

Wild collecting and/or *ex situ* curation: Specimens have been added to the Herbarium of the Instituto de Ecología, A.C. (XAL) collection. According to the results of our *ex situ* survey, there are currently eleven living collections of this species. The inclusion of *Q. delgadoana* saplings in a new *ex situ* collection in Xalapa, Veracruz is planned for 2024.

Propagation and/or breeding programs: Seedlings have been produced from seeds, and seeds have been shared with local nurseries in Xalapa, Veracruz, Mexico.

Reintroduction, reinforcement, and/or translocation: There have been 381 seedlings planted in 66 locations in central Veracruz as part of restoration plantings across a wide range of elevation and disturbed habitats including riparian vegetation, pasturelands, secondary forests and urban forests. The potential for assisted migration is being assessed. Additionally 100 saplings will be planted throughout 2024.

Research: The effect of pre-germination treatments was evaluated under controlled conditions, revealing that *Q. delgadoana* exhibited a germination rate of 82% (Castañón-Malpica, 2024). The survival and growth of transplanted seedlings is being monitored at 66 locations, and their response to varied environmental variables will be evaluated. A recent study investigated drought events and wood anatomy sensitivity in *Q. meavei* and *Q. delgadoana* (Argüelles-Marron et al., 2023). The authors found both *Q. meavei* and *Q. delgadoana* showed high resilience, resistance, and recovery to drought.

Education, outreach, and/or training: A botanical data sheet with recommendations for propagation in local nurseries has been published, and local technicians and students have been trained to identify the species. In addition, an action plan for the conservation of this species together with other oak species from the cloud forest in the upper watershed of river La Antigua is being prepared.

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

PRIORITY CONSERVATION ACTIONS

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

Land protection

This is the highest priority conservation action for *Q. delgadoana*. Less than 10% of the native range of this species is currently protected.

Reintroduction, reinforcement, and/or translocation

Quercus delgadoana is currently part of an active reintroduction program, and this conservation activity should continue to be a priority going forward. Assisted migration to environmentally suitable sites should also be investigated. *Quercus delgadoana* is a cloud forest species, which is especially vulnerable to the effects of climate change.

Propagation and/or breeding programs

Quercus delgadoana is currently being propagated and seedlings distributed to regional nurseries. This should continue to be a priority for the future.

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