

# Conservation Gap Analysis of Native Mesoamerican Oaks



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## Species profile: *Quercus rubramenta*

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### CRITICALLY ENDANGERED

*Quercus graciliformis*  
*Quercus mulleri*

### ENDANGERED

*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 rubramenta* Trel.

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

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## DISTRIBUTION AND BIOLOGY

*Quercus rubramenta* is found in the Sierra Madre del Sur, primarily in the state of Guerrero (Figure 1). It is also known from a single locality in western Oaxaca, 25 km southwest of Tecomaxtlahuaca. *Quercus rubramenta* inhabits montane cloud forests, oak-pine forests and humid oak forests where it forms pure stands. In Guerrero near the municipality of Zapotitlán Tablas, *Q. rubramenta* and *Pinus teocote* dominate the plant community (Rodríguez Pacheco et al., 2023). Known occurrences of *Q. rubramenta* occur primarily in two Holdridge life zones: warm temperate moist forest and subtropical moist forest (Figure 2). It is a high altitude species (2,200–2,800 m) and prefers flat or very slightly sloping areas (Valencia-A and Jiménez-Ramírez, 1991). *Quercus rubramenta* is a large tree that can reach heights up to 40 m. Leaves are ovate-lanceolate to elliptic, 10–20 cm long x 3–7 cm broad with entire margins.

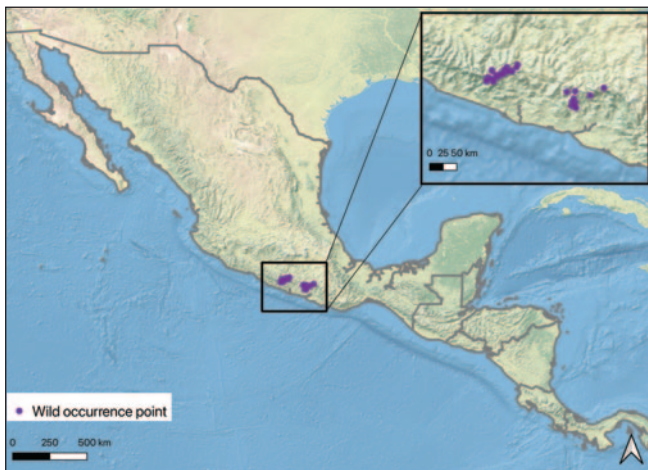
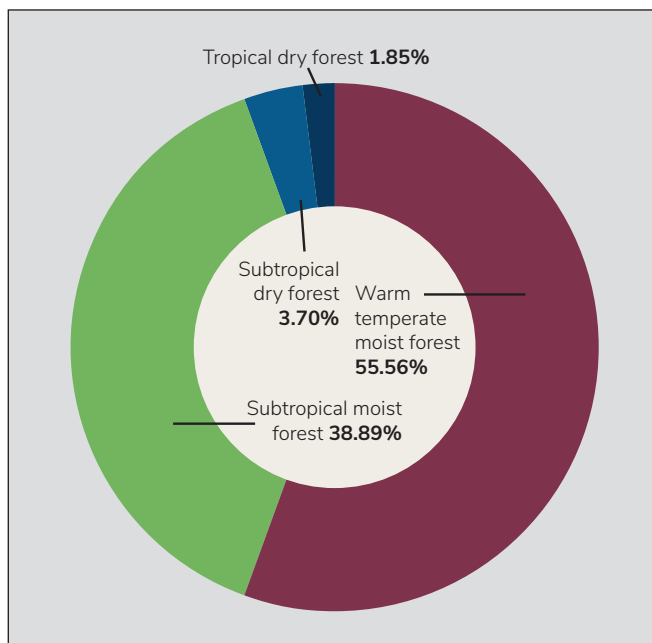


Figure 1. Wild (i.e., *in situ*) occurrence points for *Quercus rubramenta*.



Maricela Rodríguez Acosta



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

## THREATS TO WILD POPULATIONS

**Human use of species — wild harvesting:** The wood of *Q. rubramenta* is used for beams in housing construction.

**Human use of landscape — agriculture, silviculture, ranching, and/or grazing:** Subsistence agriculture, ranching, and growing of illicit crops is the most significant source of habitat loss in Guerrero. Deforestation affects the riparian areas which causes a decrease of the water table.

**Human use of landscape — residential/commercial development, mining, and/or roads:** Unknown.

**Human use of landscape — tourism and/or recreation:** This is not currently considered a threat. There is no tourism in the area where this species develops.

**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 native range of *Q. rubramenta* there is a trend towards more frequent droughts, lack of water in the soil and a decrease in humidity. *Quercus rubramenta* is especially vulnerable to climate change because it is a high-elevation species. There are few areas of suitable habitat and elevation where this species could establish as a result of increasing temperature. Within the inferred native range of *Q. rubramenta*, the warm temperate moist forest is expected to decrease in area by an average of 79% by the years 2061–2080 relative to current conditions (Good et al., 2024).

**Genetic material loss — inbreeding and/or introgression:** There is some evidence that suggests sporadic hybridization with *Q. laurina*.

**Pests and/or pathogens:** Unknown.

**Extremely small and/or restricted population:** There are a good number of populations in the area, but all of them in the same type of vegetation (cloud forest). Currently there is no information about sites other than Toro Muerto in Guerrero state.

## 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. rubramenta* (Table 1). 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 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

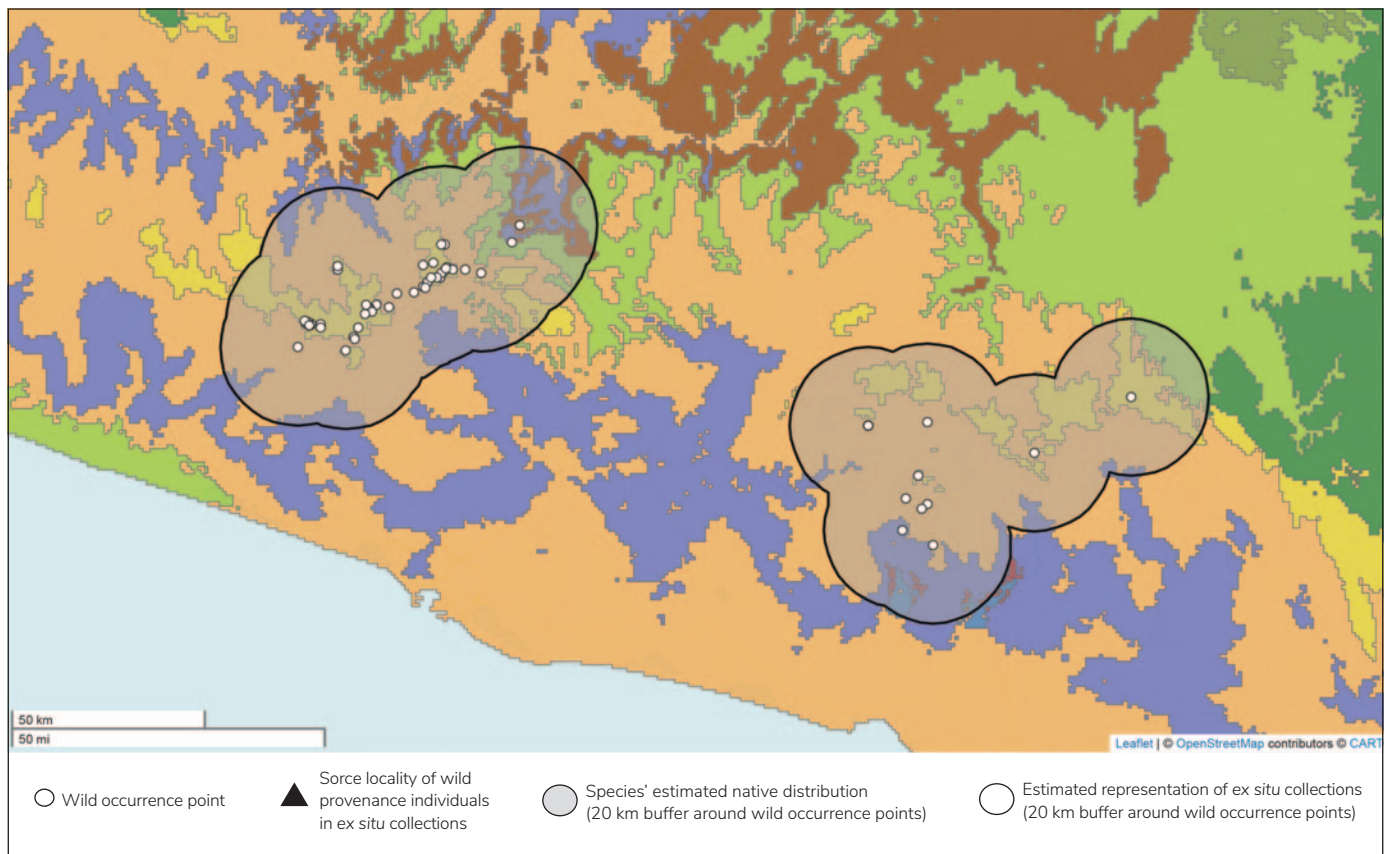
**Table 1.** Results of 2017–2022 ex situ surveys.

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

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.



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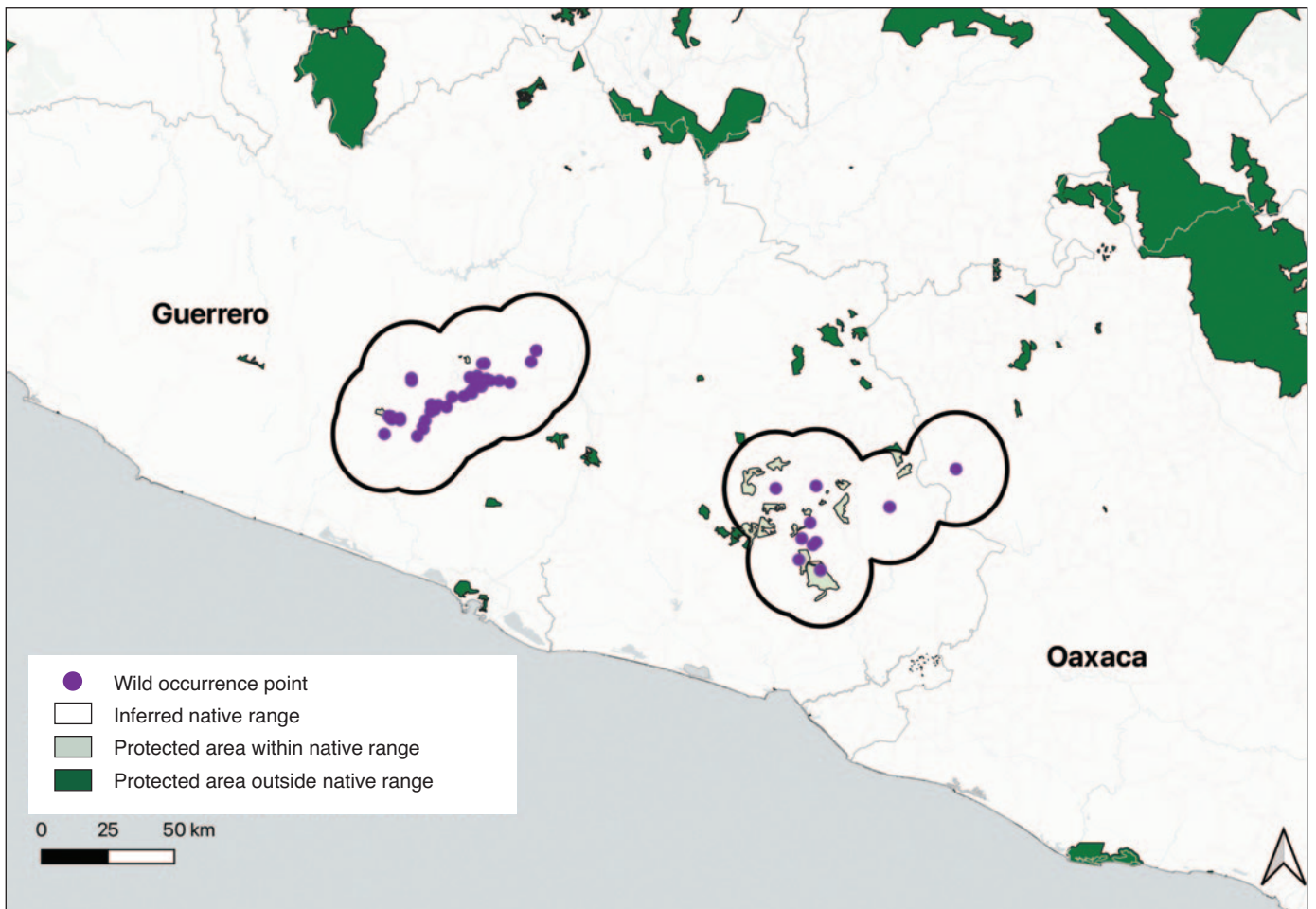
**Figure 3.** *Quercus rubramenta* wild occurrence points and ex situ collection source localities. Colored regions are Holdridge life zones. All ex situ collection source localities are also wild occurrence points.

**Table 2.** Ex situ conservation scores for *Quercus rubramenta* 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. rubramenta* 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 rubramenta* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).

**Table 3.** *In situ* conservation scores for *Quercus rubramenta* 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>	3
Ecological coverage <i>in situ</i>	50
Species representation in <i>in situ</i> collections	2
Final <i>in situ</i> conservation score	19

**Land protection:** Within the inferred native range of *Q. rubramenta*, 3% is within protected areas (Figure 4). In eastern Guerrero state there are several small Voluntary Conservation Areas where *Q. rubramenta* occurs.

**Sustainable management of land:** Unknown.

**Population monitoring and/or occurrence surveys:** There is a survey and propagation project financed by the International Oak Society (IOS) currently in progress. It is understood to be the first of its type. This oak has been growing together with *Q. laurina* and few other *Quercus* species yet to be identified.

**Wild collecting and/or ex situ curation:** Puebla University Botanic Garden (JBU-BUAP) is participating in a collection of this species and *Quercus* related to it. There are now young plants from the 2023 collections at JBU-BUAP. It is expected that JBU-BUAP will coordinate the cultivation of this species in other botanic gardens in Mexico that have the particular climatic characteristics needed for maintaining this species. Because this collection occurred after our last ex situ survey took place, it is not reflected in the results.



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**Propagation and/or breeding programs:** There is an active propagation program for *Q. rubramenta*. As of 2023, 290 seedlings with known wild provenance have been propagated for ex situ conservation and 3,000 for in situ conservation.

**Reintroduction, reinforcement, and/or translocation:** It is expected that 3,000 plants of *Q. rubramenta* will be planted in situ in 2024.

**Research:** There have been very few studies focused on *Q. rubramenta*. Cruz-Cárdenas et al. (2014) generated species distribution models for three species characteristic of Mexican humid mountain forest, including *Q. rubramenta*. Their results demonstrated the use of principal component analysis (PCA) when selecting environmental predictor variables in generating distribution models.

**Education, outreach, and/or training:** The local community has been informed about the importance of this species.

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

## PRIORITY CONSERVATION ACTIONS

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

### Land protection

Less than 5% of the native range of *Q. rubramenta* is covered by protected areas. Establishment of this species within protected areas is the most important conservation activity to prevent additional losses of trees. Land protection in Guerrero state, while necessary, would be an extremely difficult task due to the level of insecurity with the area.

### Education, outreach, and/or training

Education that allows the local community to be involved in the care of the species should be a priority.

### Propagation and/or breeding programs

Continuing to grow the propagation program for this species is necessary to ensure its survival and allow for the possibility of assisted migration.

### Reintroduction, reinforcement, and/or translocation

In addition to the planned reintroduction effort for this species in 2024, assisted migration should also be considered. The habitat and altitude where this species grows will be among the most affected by climate change.

### Research

There is a lack of knowledge on the periodicity of acorn production. Seed production can vary, and is dependent on the weather. In July 2023 seed production was abundant, and healthy acorns were ripe in September.

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