

# Conservation Gap Analysis of Native Mesoamerican Oaks

Glenn Ehrenberg



## Species profile: *Quercus devia*

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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*



THE  
CHAMPION  
of TREES



# Quercus devia Goldman

Common Names, Spanish: Encino negro

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

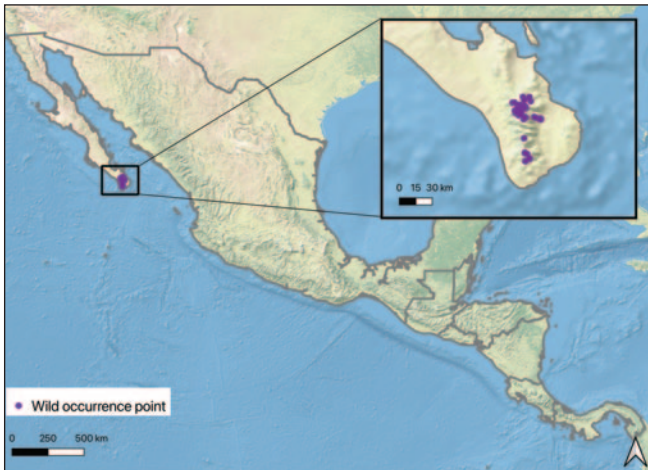
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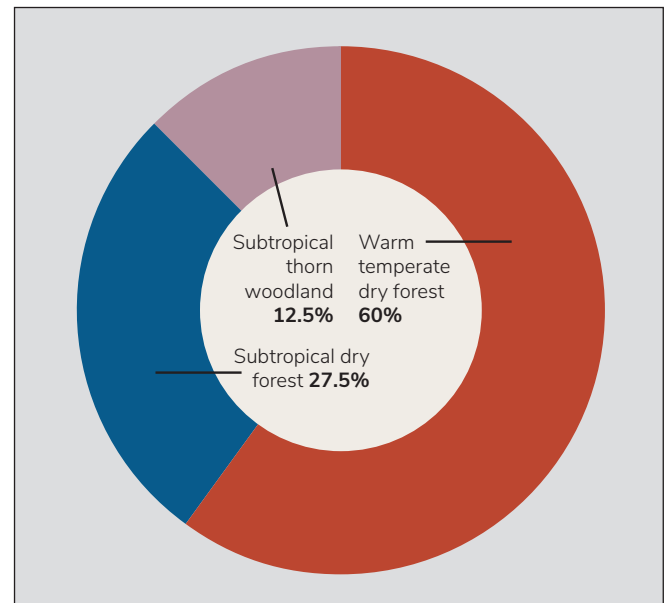
## DISTRIBUTION AND BIOLOGY

*Quercus devia*, or encino negro, is endemic to the mountains of the Sierra de la Laguna in Baja California Sur (Figure 1). It is a dominant species of the pine-oak forests at elevations 600–1,800 m asl (Daniel Perez, personal communication, 2023). Associated species in this forest type include *Pinus cembroides* var. *lagunae*, *Arbutus peninsularis*, and *Nolina beldingii* (León de la Luz and Domínguez-Cadena, 1989). Wild occurrences of this species have been recorded in three Holdridge life zones: warm temperate dry forest, subtropical dry forest, and subtropical thorn woodland (Figure 2).



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

*Quercus devia* reaches an average height of 10 m with a diameter of 40 cm (Passini and Pinel, 1989). Leaves are elliptical, acute or cuspidate at the apex and rounded or cordate at the base. Acorns are small, averaging 15–17 mm long and 7.6–8.4 mm in diameter (Goldman, 1916).



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

## THREATS TO WILD POPULATIONS

**Human use of species — wild harvesting:** When *Q. devia* is found near developments such as ranches, it is likely that there is wild harvesting for firewood. However, this is not considered a major threat.

**Human use of landscape — agriculture, silviculture, ranching, and/or grazing:** Livestock and domesticated species have been introduced to the region, often with significant overgrazing.

**Human use of landscape — residential/commercial development, mining, and/or roads:** The Sierra La Laguna Biosphere Reserve is under threat from proposed mining operations, especially gold.

**Human use of landscape — tourism and/or recreation:** Ecotourism is an increasingly popular activity within the Sierra La Laguna Biosphere Reserve, with approximately 1,340 tourists from Mexico and 540 foreign tourists every year (UNESCO, 2018).

**Human modification of natural systems — altered fire regime, pollution, eradication:** Forest fires are a major threat to the Sierra la Laguna Biosphere reserve. Large fires that can last months occur at least once a century (León-de la Luz and Domínguez-Cadena, 2010). Ground level fires are most common, but more destructive crown level fires are possible due to accumulation of deadwood and debris. Most old trees in the oak-pine forest within the reserve display fire scars.

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

**Climate change — habitat shifting, drought, temperature extremes, and/or flooding:** As a restricted range species, *Q. devia* is especially vulnerable to climate change. A recent study investigated the effect of climate change on *Q. devia* under two future scenarios; a “worst case” scenario that predicts a high increase in global temperatures, and a “best case” scenario that predicts less temperature increase. Under both scenarios, the authors found that *Q. devia* was predicted to lose more than 95% of suitable habitat (Ramírez-Preciado et al., 2019).

**Genetic material loss — inbreeding and/or introgression:** Muller (1965) noted that there is evidence of introgression between *Q. devia* and *Q. viminea*, a species of oak that occurs in Mexico (Sonora, Chihuahua, Aguascalientes, Durango, Jalisco, Nayarit, Sinaloa, Guanajuato, and San Luis Potosí) and the United States (Jerome, 2017). More work is needed to confirm this and to determine if it poses a threat.

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

**Extremely small and/or restricted population:** *Quercus devia* is restricted to the southern tip of the Baja California peninsula, Mexico.



Jon P. Rebman

## 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. devia* (Table 1). Past, present, and planned conservation activities for Mesoamerican oak species of concern were also examined through literature review and expert consultation.

**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

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 native range. The species representativeness ex situ was

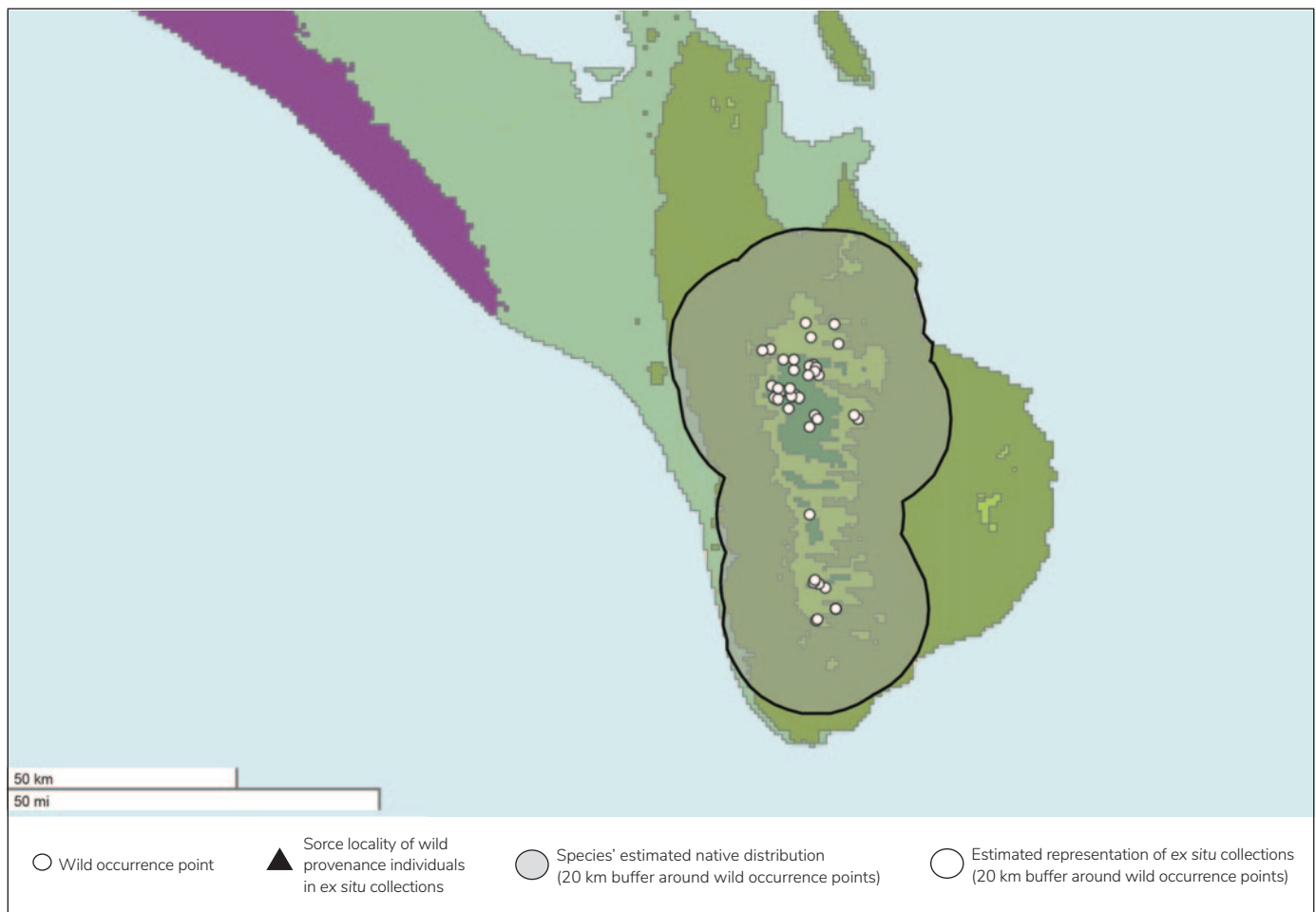
**Table 2.** Ex situ conservation scores for *Quercus devia* with all scores ranging from 0–100. A final score of 100 indicates comprehensive ex situ conservation, and a score of 0 represents poor ex situ conservation.

Geographic coverage ex situ	0
Ecological coverage ex situ	0
Representation in ex situ collections	0
Final ex situ conservation score	0

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.

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

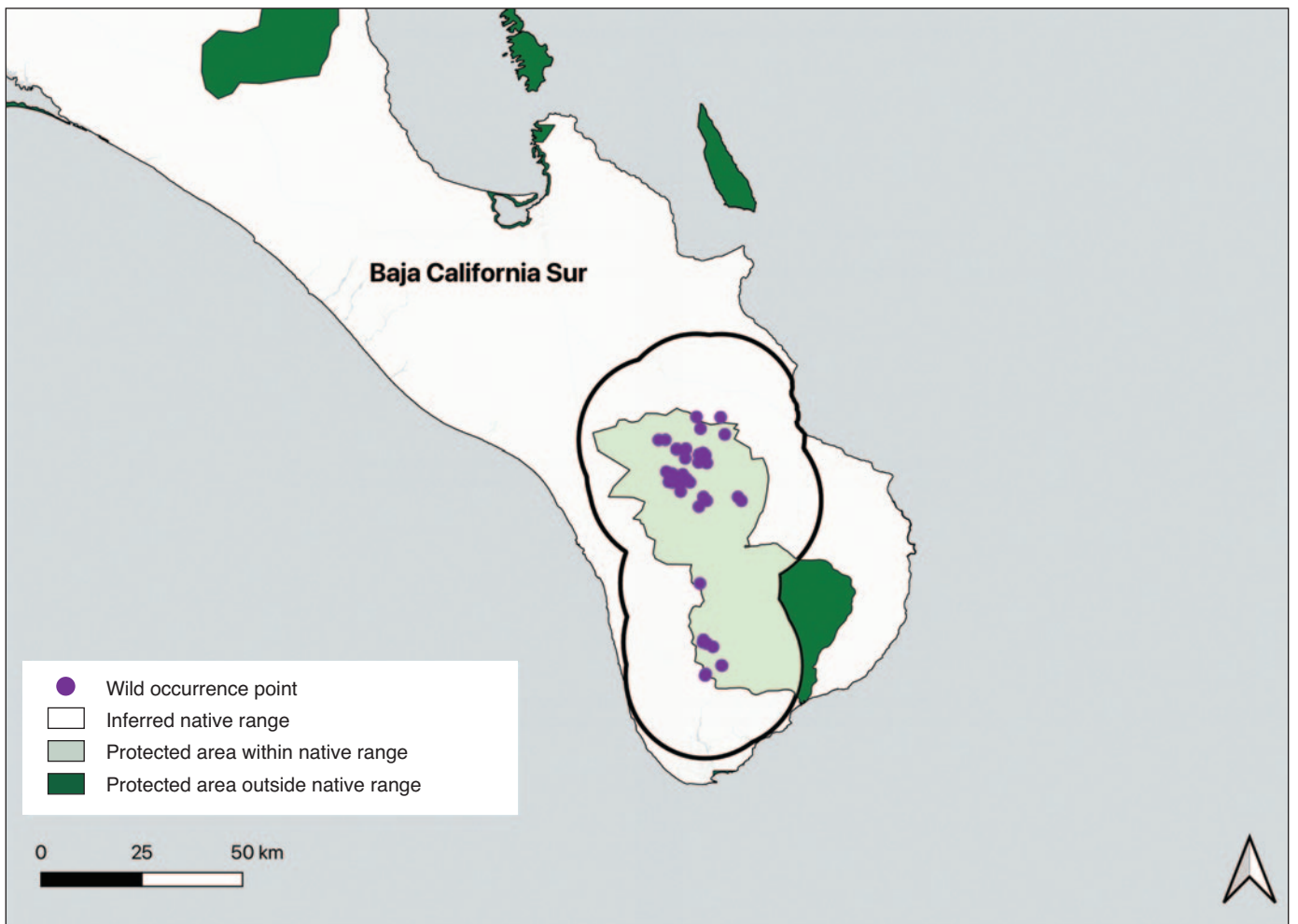




**Figure 3.** *Quercus devia* wild occurrence points. Colored regions are Holdridge life zones.

**Table 3.** *In situ* conservation scores for *Quercus devia* 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>	41
Ecological coverage <i>in situ</i>	75
Species representation in <i>in situ</i> collections	94
Final <i>in situ</i> conservation score	70



**Figure 4.** Wild occurrence points and inferred native range of *Quercus devia* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).

**Land protection:** Within the inferred native range of *Q. devia*, 41% is within protected areas (Figure 4). In addition, 94% of all known occurrence points are located within protected areas, specifically the Sierra La Laguna Biosphere Reserve.

**Sustainable management of land:** Much of the population of *Q. devia* occurs within the Sierra La Laguna Biosphere Reserve. All biosphere reserves in Mexico are required to have a management plan, which regulates activities in the area and ensures that objectives of the reserve are achieved (Ortega-Rubio and Argüelles-Méndez, 1999).

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

**Wild collecting and/or ex situ curation:** This is not a conservation activity at the time of publication. This species is not currently held in any ex situ collections.

**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 relatively little research focused on *Q. devia*. A recent study looked at the impact of climate change on the distribution of *Q. devia*, along with other species (Ramírez-Preciado et al., 2019).

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

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

## PRIORITY CONSERVATION ACTIONS

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

### Research

More research is needed that focuses on recruitment. Very few oak seedlings of *Q. devia* are found, and the reasons for this are not currently known. According to local botanists who were involved in a recent expedition to the area, recruitment was not observed even in areas where livestock is restricted.

### Species protection policies

Work is underway to develop the State Standard Proposal for the Protection of Native Plants in Baja California Sur, which would offer protection of oaks such as *Q. devia* at the state level. Efforts to pass this proposal should be a priority.

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