Conservation Gap Analysis of Native

Mesoamerican Oaks


Noel Alvarez

Species profile: ***Quercus nixoniana***

Kate Good, Susana Valencia-A, Maribel Arenas Navarro,
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 Morton Arboretum | THE CHAMPION of TREES
Global Conservation Consortium Oak
CSS TREES Center for Species Survival
Franklinia Foundation

Quercus nixoniana S.Valencia & Lozada-Pérez

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

Species profile experts: **Susana Valencia-A,** Universidad Nacional Autónoma de México (UNAM);
Maribel Arenas Navarro, Universidad Nacional Autónoma de México (UNAM)

Suggested citation: Good, K., Valencia-A., S., Arenas Navarro, M., and Alvarez-Clare, S. (2024). *Quercus nixoniana* S.Valencia & Lozada-Pérez. 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. 269-276). Lisle, IL: The Morton Arboretum.

DISTRIBUTION AND BIOLOGY

Quercus nixoniana is endemic to the Sierra Madre del Sur, Mexico, where it occurs in the states of Guerrero, Oaxaca and Jalisco (Figure 1). In addition to the occurrences in south central Oaxaca, there are also reports of this species further north in the state near San Felipe Usila and Santiago Atitlán that should be verified. It is a rare cloud forest species that inhabits pine-oak forests and mesophilic mountain forests at an altitude of 1,300–2,300 m (Valencia-A and Lozada Pérez, 2003). Half of all known occurrence points of *Q. nixoniana* are in the subtropical moist forest life zone (Figure 2).

Quercus nixoniana is a large tree that can reach up to 25 m tall. Leaves are leathery and elliptical to lanceolate, 7–16 x 1.1–2.1. cm This species fruits annually, and fruit are in groups of 2–3. Acorns are ovoid and 9.0–17.0 X 8.2–14.0 mm.

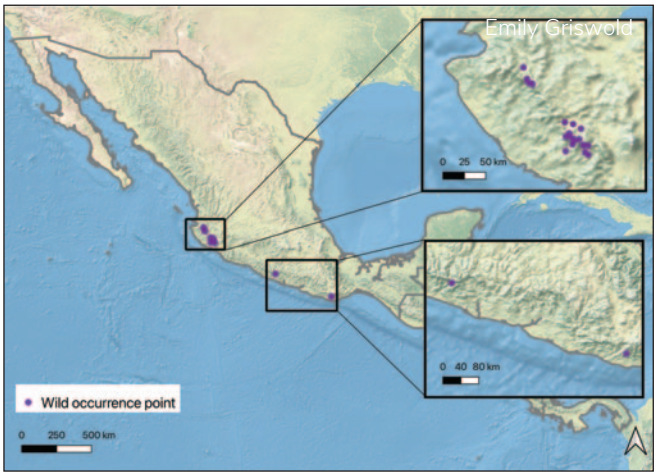

Figure 1. Wild (i.e., *in situ*) occurrence points for *Quercus nixoniana*.

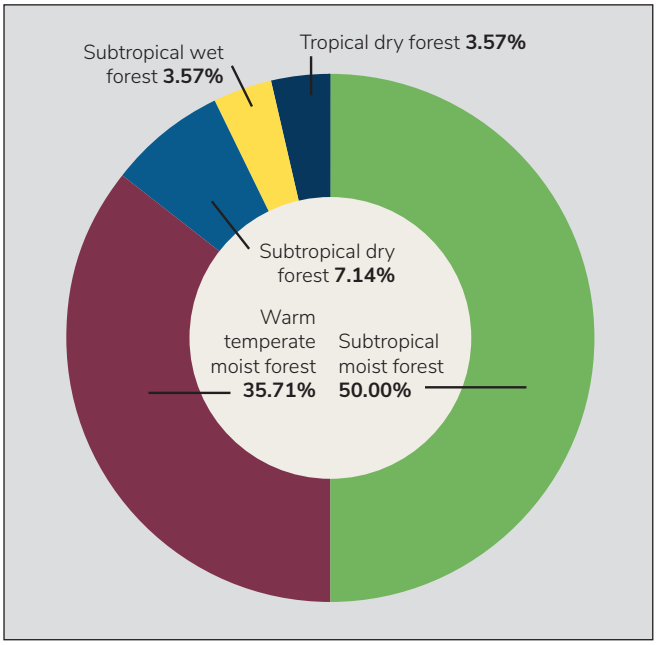

Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus nixoniana* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: This species is harvested for firewood.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: There is clearing of large areas where this species grows for cultivation.

Human use of landscape — residential/commercial development, mining, and/or roads: There is clearing of large areas where this species grows for residential development.

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

Human modification of natural systems — altered fire regime, pollution, eradication: Burned trees have been reported from the town of Río Frío in the municipality of Coyuca de Catalán, in Guerrero state. The population of Talpa de Allende in Jalisco suffered severe damage from the illegal logging that occurred around the Talpa de Allende maple forest and the subsequent fires in 2022. Only the trees in the ravines survived.

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

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: *Quercus nixoniana* prefers humid areas and grows near the banks of streams. Mexico is predicted to experience more recurrent and intense drought due to climate change, which will negatively impact this species.

Genetic material loss — inbreeding and/or introgression: There are no known hybrids of this species. However, the species distribution is fragmented and the potential for inbreeding is high.

Pests and/or pathogens: Unknown.

Extremely small and/or restricted population: This species has a fragmented distribution with extremely small populations. It is restricted to the Pacific side of the Sierra Madre del Sur in cloud forest and wet oak forest.

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. nixoniana* (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 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	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

Table 2. *Ex situ* conservation scores for *Quercus nixoniana* 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

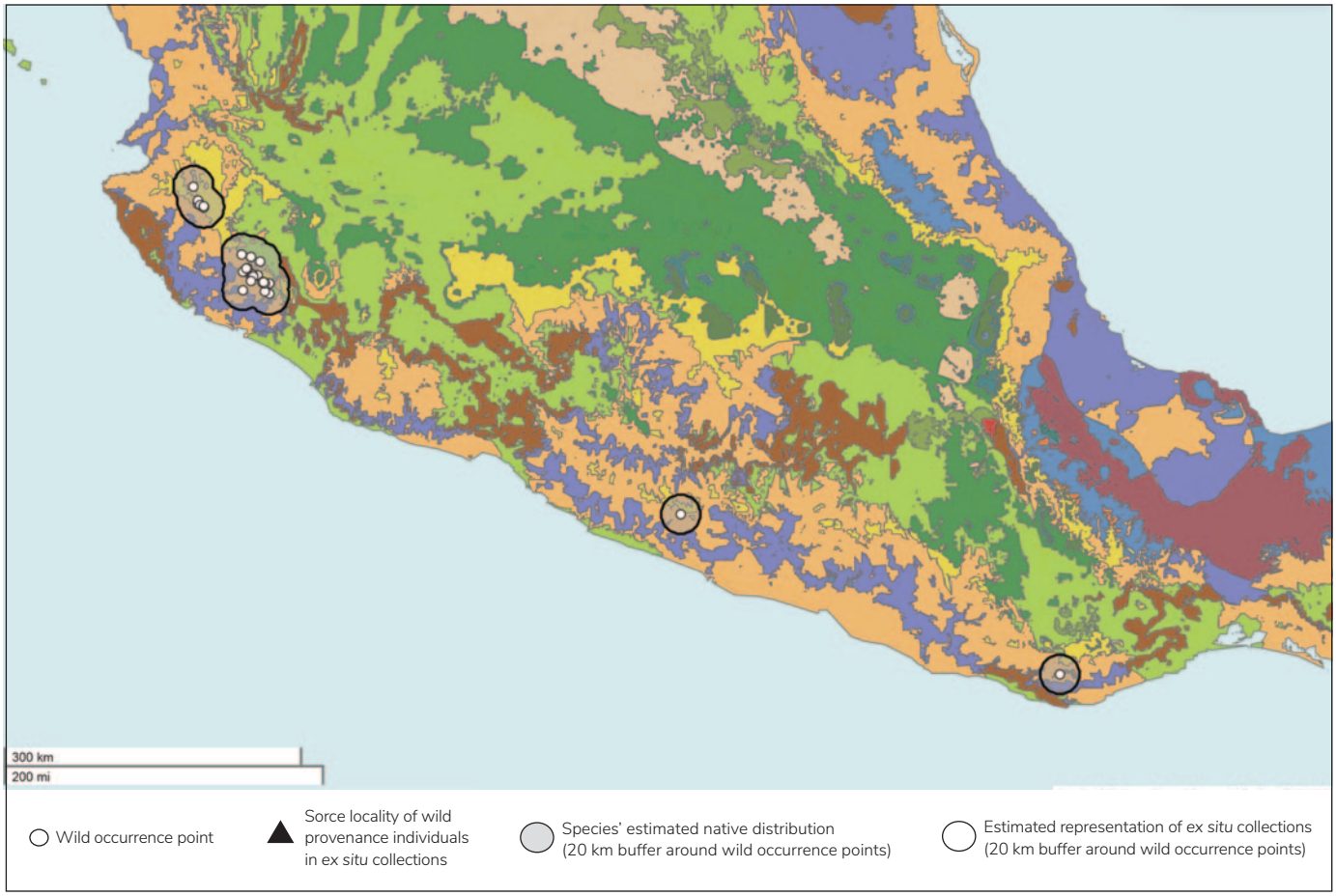

Figure 3. *Quercus nixoniana* wild occurrence points and ex *situ* collection source localities. Colored regions are Holdridge life zones. All ex *situ* collection source localities are also wild occurrence points.

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

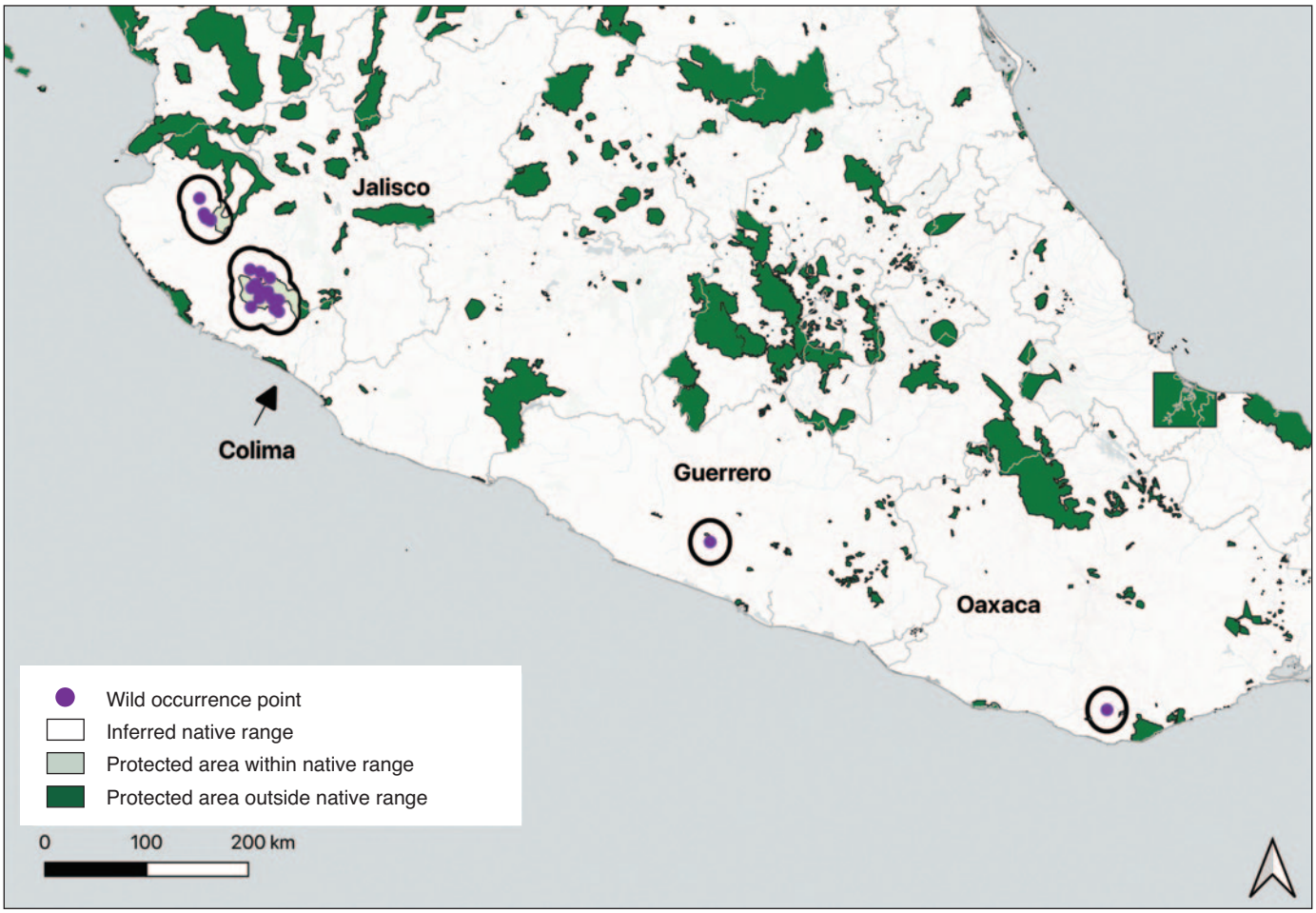

Figure 5. Wild occurrence points and inferred native range of *Quercus nixoniana* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023).


Noel Alvarez

Table 3. *In situ* conservation scores for *Quercus nixoniana* 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*	100
Species representation in *in situ* collections	44
Final *in situ* conservation score	54

Land protection: Within the inferred native range of *Q. nixoniana*, 17% is within protected areas (Figure 4). This species is known to occur within the Sierra de Manantlán Biosphere Reserve in Jalisco.

Sustainable management of land: The Sierra de Mantlán Biosphere reserve has a fire restoration and management plan (Jardel et al., 2003).

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

Wild collecting and/or *ex situ* curation: This is not a known conservation activity at the time of publication. According to the results of our *ex situ* surveys, this species is not currently held in any *ex situ* collections.

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

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

Research: Recent studies on *Q. nixoniana* have looked at the potential for assisted migration along an elevation gradient, (Garcias-Morales et al., 2023), germination time and *in situ* storage conditions (Garcias-Morales et al., 2021), as well as the environmental factors that influence distribution (Arenas-Navarro et al., 2020).

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

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

PRIORITY CONSERVATION ACTIONS

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

Land protection

Additional protected areas are needed to prevent further loss of this species in Guerrero, Oaxaca and Jalisco.

Education, outreach, and/or training

The habitat of *Q. nixoniana* is being converted for residential development and agriculture. It is also reportedly harvested for firewood. Educating the local community on the conservation value of *Q. nixoniana* is an important conservation activity.

Research

It is difficult to access places in Guerrero where *Q. nixoniana* develops, due to insecurity. As a result, details on the threats faced by this species are often unknown, such as human use of landscape and human modification of natural systems. There is also a lack of studies on reproduction (e.g., masting periodicity, acorn germination and seedling establishment).

REFERENCES

Arenas-Navarro, M., García-Oliva, F., Torres-Miranda, A., Téllez-Valdés, O., and Oyama, K. 2020. Environmental filters determine the distribution of tree species in a threatened biodiversity hotspot in western Mexico. *Botanical Sciences* 98(2): 219–237.

Garcias-Morales, C., Orozco-Segovia, A., Soriano, D., and Zuloaga-Aguilar, S. 2021. Effects of *In Situ* Burial and Sub-Optimal Storage on Seed Longevity and Reserve Resources in Sub-Tropical Mountain Cloud Forest Tree Species of Mexico. *Tropical Conservation Science* 14: doi:10.1177/1940082921989196

Garcias-Morales, C., Zuloaga-Aguilar, S., Soriano, D., Ortiz-Arrona, C., and Orozco-Segovia, A. 2023. Assisted Migration Along an Elevational Gradient for Seedlings of Tree Species from the Montane Cloud Forest. Available at SSRN: https://ssrn.com/abstract=4642673 or http://dx.doi.org/10.2139/ssrn.4642673

Jardel P. E. J., Ramírez-Villeda, R., Castillo-Navarro, F., and Balcázar, M. O. E. 2003. Fire management and restoration plan in the Sierra de Manantlán biosphere reserve, México. In: 'Proceedings of the 5th symposium on fire and forest meteorology joint with 2nd international wildland fire ecology and fire management congress, 16-20 November 2003 Orlando, FL.

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.

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

Valencia-A, S., and Lozada Pérez, L. 2003. *Quercus nixoniana* (Fagaceae), una nueva especie de la Sección Lobatae, de la Sierra Madre del Sur, México. *Novon*: 261-264.